This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

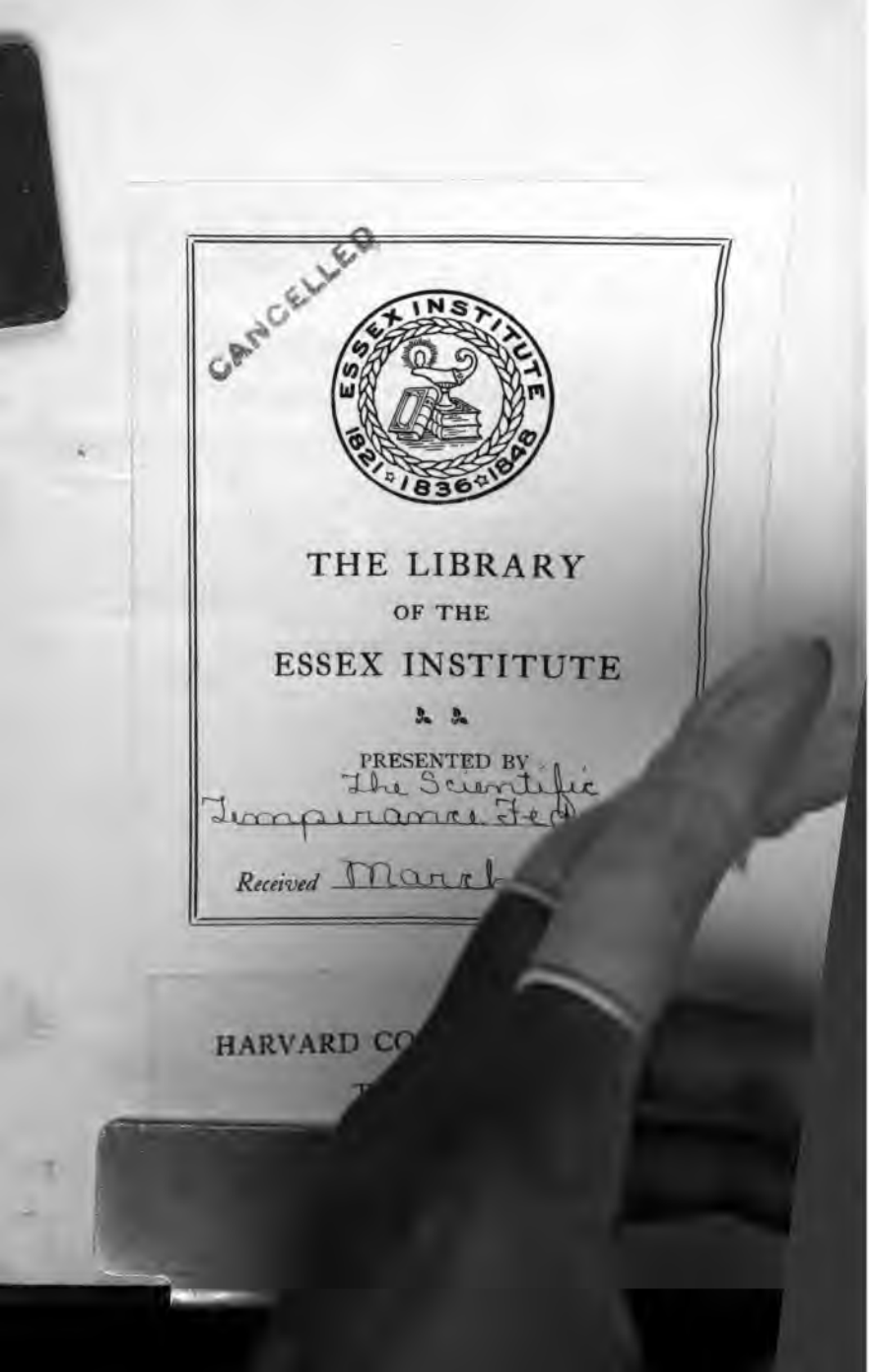
+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

EducT
398.98
420


CANCELLED
ESSEX INSTITUTE
1821 ☆ 1836 ☆ 1848
THE LIBRARY
OF THE
ESSEX INSTITUTE
PRESENTED BY
The Scientific
Received March
HARVARD CO

3 2044 097 031 744

Educ T 398.98.420

CANCELLED

THE LIBRARY
OF THE
ESSEX INSTITUTE

PRESENTED BY
The Scientific
Temperance Federation
Received March 13, 1915.

HARVARD COLLEGE LIBRARY
THE GIFT OF
GEORGE ARTHUR PLIMPTON

72-
3 2044 097 031 744

SUGGESTIONS

FOR

PRIMARY AND INTERMEDIATE

LESSONS ON THE HUMAN BODY

A Study of its Structure and Needs Correlated with Nature Study

BY

MRS. ELLA B. HALLOCK

LECTURER ON THE TEACHING OF PHYSIOLOGY, HYGIENE, AND TEMPERANCE BEFORE THE MASSACHUSETTS TEACHERS' INSTITUTES

DRAWINGS BY DAVID C. LITHGOW

NEW YORK AND CHICAGO

E. L. KELLOGG & CO.

Educ T 398.98.420

[illegible] COLLEGE LIBRARY
GIFT OF
GEORGE ARTHUR PLIMPTON
JANUARY 25, 1924

"The more I think of it, the more I find this conclusion impressed upon me, that the best thing a human soul does in this world is to SEE *something, and tell what it saw in a plain way. Hundreds of people can talk for one who can think, but thousands can think for one who can* SEE."—RUSKIN.

Copyright, 1898, by
E. L. KELLOGG & CO.,
NEW YORK.

PREFACE.

It was my privilege to visit many schools with a view to learning how physiology and hygiene were taught. While good has been accomplished by the teaching of these subjects, the results are small when compared with what they would be, could physiology and hygiene find their true place in relation to the other subjects taught, and could the same scientific methods be employed in teaching them that are used in teaching the other sciences.

In the lower grades, especially, physiology and hygiene occupy an isolated place, being completely cut off from those subjects with which they are naturally related and in which the pupils are interested. The method employed in teaching is mainly either the narrative or the text-book method. The subject-matter suggested in courses of study for primary grades is, in most cases, well adapted to the capacity of young children, being a study of the external parts of the body, as the arm, the leg, the trunk, etc., together with the general needs of the body, as food, water, air, etc.

In this book I have taken the topics of the outline generally used, and endeavored to work them out in detail and relate them to topics in Nature Study or Science Work, continuing the study of the principal parts of the body until their internal as well as their external structure is included.

There is no attempt to outline a complete course in Nature Study. The pupils in nearly all the schools observed, are studying plants, animals, air, water, etc. It is only a step from the consideration of these topics to those relating to the structure and needs of the human body, and it is this step that I would indicate to teachers, and suggest methods by which the latter can be taught in an interesting and profitable manner.

An inflexible program cannot be laid down for the different months of the year in the several grades, as the topics of this subject must vary with those in Nature Study in the different schools. The order, therefore, in which the topics are treated in this work is not necessarily the order in which they are to be presented. Each teacher will select such topics as are related to the other work being done in her grade, and, it is hoped, will find in this book materials and suggestions in methods that will be of real service to her in her teaching.

E. B. H.

INTRODUCTION.

AIMS.

To teach simple truths relating to the structure and needs of the human body in their proper relation to other topics.

To train pupils in observation, thought, and expression.

To train pupils in habits that lead to health, strength, cleanliness, temperance, and grace.

MEANS.

Objects, including animals, plants, foods, etc., when obtainable.

Prepared specimens, such as bones, muscles, etc.

Large pictures of the objects studied, mounted on manila paper, or sketches of the same, for which the illustrations in the book will serve as suggestions to the teacher.

Good charts.

Blank books for the pupils, in which sketches may be made and statements entered.

Good Health Club Leaflets, in which statements relating to right living may be entered.

A collection of stories, poems, and songs, to be gathered by the teacher from various sources, and used according to her judgment.

Games, marches, and exercises to illustrate or emphasize points of importance.

Such books of reference for the pupils as the teacher may see fit to place within their access.

Such physiologies as the school board or committee may specify for the use of the pupils, to be used only as books of reference or as supplementary readers.

Books of reference for the teacher, as follows :

ORTON.—Comparative Zoology. Harper Brothers, N. Y.

NEEDHAM.—Elementary Lessons in Zoology. American Book Co., N. Y.

COLTON.—Practical Zoology. D. C. Heath & Co., Boston.

HOOKER.—Child's Book of Nature. Part II. American Book Co., N. Y.

BERT.—Primer of Scientific Knowledge. Lippincott, Phila.

HOPKINS.—Observation Lessons. Part III. Lee & Shepard, Boston.

FOSTER & SHORE.—Physiology for Beginners. Macmillan, N. Y.

LINCOLN.—Hygienic Physiology. Ginn & Co., Boston.

MARTIN.—The Human Body and the Effect of Narcotics. Henry Holt & Co., N. Y.

RICHARDSON.—Temperance Lesson Book. National Temperance Society, N. Y.

WOOD-ALLEN.—Marvels of Our Bodily Dwelling. Wood-Allen Pub. Co., Ann Arbor, Mich.

AMERICAN PUBLIC HEALTH ASSOCIATION.—Prize Essays. Henry Lomb, Rochester, N. Y.

LINCOLN.—Essentials of School Hygiene. Dr. J. F. Lincoln, Boston.

BISSELL.—Manual of Hygiene. Baker & Taylor Co., N. Y.

LINDLEY.—Health in the Home. E. M. Lindley, Murray Hill Hotel, N. Y.

REYNOLDS.—Primer of Hygiene. Macmillan & Co., N. Y.

ATWATER.—Pamphlet, Foods. Dept. of Agriculture, Washington, D. C.

All the bulletins issued by the U. S. Dept. of Agriculture on the source, treatment, and cooking of foods.

STEVENSON.—Boys and Girls in Biology. D. Appleton, N. Y.

LOVEJOY.—Nature in Verse. Silver, Burdett & Co., Boston.

Games and Motion Songs, see p. 36.

In response to the request by teachers for helps in teaching the origin of life, the following books are suggested :

MORLEY.—Seed Babies. Ginn & Co., Boston. The Song of Life. McClurg & Co., Chicago.

WOOD-ALLEN.—Teaching Truth ; Child Confidence Rewarded ; and other pamphlets. Wood-Allen Pub. Co., Ann Arbor.

METHODS—GENERAL SUGGESTIONS.

Relate the lessons on the structure and the needs of the human body to the lessons on animals, plants, air, water, soil, sunshine, and other topics with which the former are closely connected.

In the lowest grades study the human body externally.

Lead the pupils to observe the principal parts of the body and compare and contrast them with the corresponding parts of lower animals, with reference to their position, size, form, color, motion, and use, determining the simple reasons for the resemblances and differences discovered.

Relate the lessons to healthful living by discovering and emphasizing the right use of the various parts of the body, and by training the pupils in the proper use of these parts.

Observe the pupils carefully in regard to their condition and habits, and learn also, if possible, the condition of their homes. In correcting the faults discovered, seldom call the attention of the pupils to them, but attain the end in view by leading the pupils, often unconsciously, for days, weeks, or months in ways of right living.

As a rule, avoid directions and mottoes beginning with "Don't." Approach, as far as possible, questions relating to health and morals from the right and the bright side. In teaching this subject, as every other, fill little children's minds with correct ideals—ideals of health, purity, and beauty.

In all the hygienic teachings, keep this thought in mind: the most effective lessons are conveyed by the life

of the teacher. What she would lead the children to practise must be exemplified in her own life. A realization of the importance of a subject, enthusiasm, and a desire to bring something that is really good into the lives of the pupils, must characterize the successful teacher of hygiene.

Lead the pupils not only to see and to repeat what is right, but to practise it. To this end, in each grade form the Good Health Club in the following manner:

Supply every pupil with a folder or blank-book, at the top of the first page of which are written these words: "As I wish to be healthy, happy, and useful, I will try to keep these rules," or "As I wish to live the best life possible, I will try to keep these rules."

The teacher will be president of the Club and the pupils members.

Each member will be free to accept or reject any rule.

Slowly, week by week, as better ways of living are discovered, rules are formulated and entered in the leaflet. In the end the members of the Club will be following a regulated "day's order" that touches the physical life at every important point. The rules will relate to rising; bathing; dress; diet; hygiene of eating; abstinence from all injurious articles; breathing; ventilation; exercise, including work and play; position and carriage of the body; rest; and sleep.

In a word, teach physiology and hygiene in as scientific a manner as any other subject is taught, applying the following general directions that are observed by the true teacher in teaching all other subjects:

Have the aims of each exercise clearly in mind.

Prepare carefully, that there may be no waste of time or of energy, or failure in accomplishing the aims. Have the necessary helps at hand and present the subjects attractively.

Require careful observation and thought on the part of the pupils. When pupils fail to discover the truths you would have them know, aid them by skilful questioning.

Require clear, accurate oral descriptions; require clear, accurate written descriptions; require outline drawings and modeling in clay of some of the objects studied.

Remember that young children soon weary of a topic. Select, therefore, suitable topics, and treat them as briefly as is necessary in order to sustain the interest of the pupils.

No teacher, probably, will be so unwise as to attempt to teach all the topics that are suggested for any one grade in this book. The character of the topics, the order in which they are pursued, and the thoroughness with which they are treated must be determined by individual teachers.

TABLE OF CONTENTS.

		PAGE
PREFACE		3
INTRODUCTION		5–9
	STRUCTURE.	
CHAPTER I.	—LIFE—THE HUMAN BODY	10–22
II.	—THE FORE-LIMBS OF ANIMALS—THE ARM.	24–38
III.	—MEANS OF LOCOMOTION—THE LEG	40–59
IV.	—THE TRUNK	60–65
V.	—THE HEAD AND NECK	67–76
	ORGANS OF SPECIAL SENSE.	
VI.	—THE SKIN	78–82
VII.	—THE MOUTH	83–84
VIII.	—THE NOSE	85–88
IX.	—THE EAR	89–96
X.	—THE EYE	97–106
	NEEDS OF THE BODY.	
XI.	—AIR	107–123
XII.	—FOOD	124–154
XIII.	—WATER	155–170
XIV.	—SUNSHINE	171–176
XV.	—CLOTHING	177–180
XVI.	—EXERCISE AND REST	181–184
	TEMPERANCE.	
XVII.	—TEMPERANCE TEACHINGS	185–194

STRUCTURE.

CHAPTER I.

LIFE.—THE HUMAN BODY.

Helpful Books.—Orton's Comparative Zoology, Needham's Elementary Lessons in Zoology, Bert's Primer of Scientific Knowledge, Hooker's Child's Book of Nature, Part II., Marvels of Our Bodily Dwelling.

SUGGESTIONS IN METHODS.

The observations made by primary pupils will not form the basis of any scientific classification. The aim is to lead pupils to see superficial resemblances and differences at the beginning of their study of animals. This habit of observing and comparing will lead, however, in after years, to a true appreciation of the classification which is based upon essential points of resemblance.

It is assumed that the pupils are studying animals in a simple, attractive manner, according to schemes laid down under Nature Study, for which the following outlines cannot be used as a substitute. They aim to direct the attention of the pupils more particularly to structure.

Make large outline drawings or collect pictures of the animals to be studied, or to which reference is made.

Supply every pupil with a blank book, in which sketches can be made, pictures mounted, and statements entered.

PRIMARY.

LIFE.

Name objects that are alive that may be seen in the school-room; that may be seen from the school-room windows; that may be seen on the way to and from school; that have been seen some time in the past; whose pictures may be found in books. (Only animal life will be mentioned, probably.)

Name objects that are not alive. Compare a live object, as a bird, with one that is not alive, as a piece of coal.

Observe that the bird eats, grows, breathes, moves, feels; that it has a certain shape and is composed of certain parts. Compare with the coal in each particular. Observe other animals and other minerals.

Determine that plants eat, breathe, and grow, and therefore are to be classed with live objects. Tell the pupils in a simple manner how the plants eat and breathe.

Name the principal parts of an animal; of a plant.

In this manner lead young children to observe the many forms of life about them—what they can do, the parts of which they are composed; to feel that it is a wonderful thing to be alive; to respect and protect forms of life, plant and animal, from the tiniest to the greatest.

COMPARATIVE STUDY OF THE PRINCIPAL PARTS.

Lead pupils to observe the difference in animals in regard to the number of principal parts possessed by them.

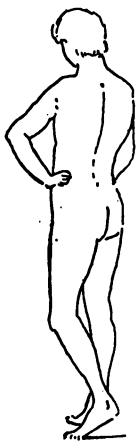
Give out problems like the following, to each of which a variety of answers may be correctly given:

Bring an outline drawing or a picture of an animal that has a body without any distinct head, neck, and limbs. Refer to the inactive life of this animal and determine that it has all the parts that it needs.

Bring an outline drawing or a picture of an animal whose body is composed of two parts—trunk and head.

Bring an outline drawing or a picture of an animal whose body is composed of three parts—head, trunk, and limbs. Refer to the habits of the animal, where it lives, the use it makes of the different parts, observing that they are all the animal needs for the life it lives.

Bring an outline drawing or a picture of an animal whose body is composed of four parts — trunk, head, neck, and limbs. Refer to the use of these parts, how all are necessary.



Observe the principal parts composing the human body—trunk, head, neck, legs, and arms.

Find the picture of an animal whose body is composed of the same parts. Refer to the habits of the monkey; the use it makes of its arms, hands, and legs in walking, climbing, and seizing; the position and shape of

the trunk and head compared with those of man and of the lower animals.

Determine the general use of the parts observed in man and their adaptation to that use in position, shape, and movement.

Determine whether man can perform all the acts done by animals, as climbing, running, flying, swimming, etc., and whether he can perform them as well as they can.

Name some of the many things man can do. Notice the great variety of acts.

Name the parts used in performing some of these acts.

Imagine some of the parts lacking and the consequent effect on man's actions.

Lead the pupils to see that in order that he may do his work in the best manner possible, man needs all the parts of his body—trunk, head, neck, legs, and arms—and must keep them in a good condition.

Have the pupils enter in the blank books drawings or pictures of the animals which they have observed, with the statement telling the number of principal parts of which each animal is composed.

"THE HOUSE BEAUTIFUL."

In studying the body as a whole in primary grades, it is not necessary to enter into details of structure, in which little children can have no interest. They are pleased, however, to discover the framework on which their bodies and those of many animals are built; that the framework is not solid, but jointed; that the bones are not bare, but covered all over with firm flesh; and that over all, fitting and yielding like a glove, is the smooth, soft skin. When very young they notice the blue markings of the veins in the wrist, and are interested to know their name and the reason why they look blue. They delight in finding the heart and feeling it beat. The fact that they have a heart

and know its position in the body seems to satisfy them. The same is true of the other internal organs. Little children in their homes watch the dressing of a fowl with an interest unmixed with the slightest repulsion, and are delighted when they learn for the first time that the chicken has a heart and a stomach as well as they. But an explanation in detail in regard to the structure and function of these organs is lost upon their young minds. In the lowest primary grades the fact of the existence of these organs in man and in many of the lower animals may be taught, with a knowledge of their general use or relation to life. (See topics, The Trunk and The Head.)

In the higher primary grades a description may be given in a figurative manner of "The House Beautiful," in which "The Man Wonderful" spends his days while here upon earth.

The teacher will find help for such a description in Dr. Mary Wood-Allen's "Marvels of Our Bodily Dwelling"—a work designed for older pupils, but which may be easily adapted by the teacher to younger ones. The terms framework, walls, sheathing, stories, pillars, cupola, thatch, kitchen, force-pump, purifying apparatus, electrical apparatus, etc., invest the literal truths with a new charm and impress them deeply upon the children's minds. The fact that the "House" cannot be exchanged, sold, rebuilt, or left in any way by the owner until he is through with earthly life, makes the pupils realize the importance of caring for the body.

INTERMEDIATE.

Before studying special parts of the body as designated in the following chapters, it is well to give the pupils an idea of the body as a whole, that they may see all the parts related and working together as a unit.

As external features have been observed in the lower

grades, attention may now be given to internal structure, observing general features of bones, muscles, and other organs composing the body, to each of which more particular reference will be made under the different topics.

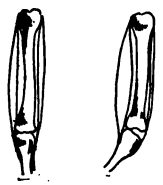
ORGANS OF MOTION.

Muscles.—Bend and straighten different parts of the body. Grasp the arm and bend and straighten the forearm. Observe the change in the size of the fleshy parts of opposite sides of the arm as it bends and straightens. Compare the two sides in the same movement.

Make a hinge joint of two pieces of wood. At the outer extremity and on opposite sides of one piece fasten two strips of india-rubber. Pass the strips over the joint and fasten them near the inner extremity of the second piece of wood. With this piece of apparatus illustrate the arrangement of the muscles in pairs, and how they act in opposition to each other.

Discover other uses of the muscles than that of producing motion, viz., covering and protecting the organs and giving shape to the body.

By means of a specimen obtained at the market, observe the arrangement in layers, the shape, tendons, and attachment of muscles.



Show by a drawing the general shape and attachment of a pair of muscles.

Observe many of the movements which the body can make. Locate in a general way the muscles that produce some of the movements.

Discover large, strong muscles; those which are small and weak; those which move quickly; those which do not seem to move at all.

Name animals that have very strong muscles; those whose muscles move very quickly.

Consider the advantage of having muscles that are strong and are able to endure and move quickly and accurately.

Bones and Joints.—Bones may be obtained from the table, the fields, and the market, for study. Clean them in the following manner: Free the bones from the flesh, boil them in a solution of soap and ammonia, then clean them with a small brush and expose them to the sun. The teacher can prepare a skeleton of a small animal in this manner. With needle and thread the bones can be mounted on cardboard. The skeleton can thus be mounted and studied in sections—the bones of the fore-limbs, hind-limbs, trunk, etc. Cross and longitudinal sections of a bone can easily be obtained at the market.

Discover the use of bones in producing motion.

Find bones that protect important organs.

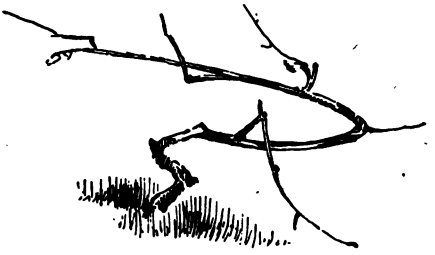
Observe how the bones form the framework and give shape to the body. Name the framework "skeleton."

Observe the location of the human skeleton with reference to the rest of the body.

Observe whether all animals have a skeleton inside the body or not. Require pupils to bring an outline sketch of an animal that has an internal bony skeleton. Name animals that have strong, heavy bones; those that have light, slender bones.

Make an outline sketch of an animal that has an external skeleton.

Make an outline drawing of an animal that has no skeleton.



Observe trees and find the part corresponding to the skeleton.

Observe the trees in winter and notice how their skeletons differ in shape; how the skeleton determines the shape of the tree.

Observe leaves and find the framework or skeleton.

Joints.—Consider the advantage of joints in producing motion.

Find many of the joints in the human body.

Determine how two sticks must be joined, or two bones, in order that one may bend upon the other and straighten again. Illustrate by means of a pocket-ruler.

Determine how the bones must be joined in order that one may move freely in many directions.

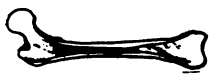
Get the fore-limb of a small animal and observe how firmly the bones of the different parts are fastened together; how some of the joints move only like a hinge, while the shoulder-joint moves more freely. Examine the structure of the latter. Teach the names, "ball and socket joint" and "hinge joint." Apply these names to different joints.

Structure of Bones.—Observe the living human body and locate the long bones; short bones; heavy bones; light bones; flat, thin bones. Observe their adaptation to use.

Study the external features of a bone. Observe its shape, knobs, enlargement at the joints, hardness, smoothness, color.

Study a cross-section of a long bone. Observe the hollow structure. Determine which will bear the most weight, a solid rod or a tube of the same material and weight. Give illustrations from nature. Observe the marrow filling the cavity.

Compare the structure of a cross-section of a long bone with that of a thin, flat bone.



Study a longitudinal section of a long bone. Observe the cavity, marrow, the hard surface, and the spongy structure of the joints.

Determine the purpose of all that is observed in the structure of the bones.

Make outline drawings of the cross and longitudinal sections of bones, showing the general features only.

Composition of Bones.— Burn bone for several hours. Compare it with fresh bone. Tell the pupils what is lacking in the burnt specimen. Determine the use of the animal matter in bones.

Soak a small bone two or three days in a ten-per-cent solution of nitric acid. Compare it with fresh bone. Tell the pupils what is lacking. Determine the use of mineral matter in bones.

Consider the difference between the bones of an old person and those of a young child.

HOW ANIMALS LIVE AND GROW.

Discover the general needs of animals—food, air, and water.

Discover additional needs of some animals, as sunshine, exercise, and rest.

Name the needs of the human body—food, air, water, sunshine, clothing, exercise, and rest.

Compare the needs of animals with those of plants.

Determine that animals live and grow by receiving food, air, and water into the body.

Determine how food is usually received into the body of animals; air.

Show by means of pictures the organs receiving and changing the food preparatory to its use in the body. Teach their names and observe the position of the organs in relation to one another.

Show in the same manner the organs receiving the air and the organ by which the prepared food or blood is sent out over the body to nourish it.

The organs that are simply mentioned here will be studied more thoroughly in regard to their structure and work in connection with other topics.

(See chapters on Food and Air.)

HOW ANIMALS FEEL.

Observe the different sensations perceived by the mind, as touch, including heat, cold, pain, weight; taste; smell; light; sound.

Determine the organs through which these sensations are received, as the skin, the mouth, etc.

Refer to the movements made by the body.

Refer to the work done by the organs in the trunk—preparing the food, purifying the blood, and sending it over the body.

Determine that the muscular movements, the work of the internal organs, and sensations are controlled by a central power.

Locate the power in the brain and spinal cord. Obtain at the market a piece of the spinal cord of an animal, also

a muscle to which a nerve is attached. Show pictures of the brain and the spinal cord and the net-work of nerves all over the body.

Compare the brain and the spinal cord to the electrical apparatus of a house—tell how messages are received through the eyes, ears, nose, mouth, and all parts of the body, and sent over the wires or nerves to one of the two central stations, the brain and the spinal cord, and how from them orders are sent out to all parts of the body. (See Marvels of Our Bodily Dwelling.)

PRIMARY AND INTERMEDIATE.

CARE OF THE BODY.

In this introductory study of the body as a whole, it is not necessary to give specific directions in regard to the care of the body. The aim should be to create a general interest in the structure of the body, and a regard for it, and to impress upon the pupils' minds the need of caring for it. Then as different parts of the body are specially studied and rules of living are formulated, they will be more likely to be followed.

Hold ever before the pupils' minds types of perfect health and strength.

Adorn the rooms with copies of the old masterpieces in painting and statuary that represent ideal types of the human form. Make the pupils familiar with these and lead them to admire the power, dignity, grace, and beauty expressed in the figures.

Describe the manner of living of the ancient Greeks—their simple habits and love of exercise.

Describe the manner of living of modern athletes and of those who desire strength for any special work.

At an early age strive to awaken a desire in the minds of the pupils not simply to live, but to live the best life pos-

sible—to get the most from life and give the most to life of which they are capable.

Determine that in order to live in this manner there must be a sound mind in a sound body.

GOOD-HEALTH CLUB LEAFLET.

Formulate and enter in the Good-health Club leaflet one general rule, expressing the above sentiment. (See p. 8.)

CHAPTER II.

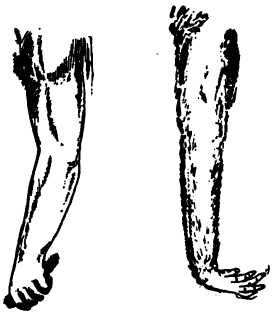
FORE-LIMBS OF ANIMALS.—THE ARM.

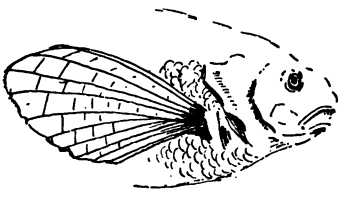
Helpful Books.—Orton's Comparative Zoology, Needham's Elementary Lessons in Zoology, Hooker's Child's Book of Nature, Part II., any standard work in Physiology, Motion Songs (titles given on another page).

SUGGESTIONS IN METHODS.

There is no special value in training young pupils to touch and name the external parts of the arm and hand, repeating, "I have an elbow," "I have two hands," etc. By this method the attention of the child is directed to himself alone, and the "I" and its possessions are unduly magnified. Train him rather, in connection with Nature Study, to see that he is a part of the animal creation, and that the members that he has are possessed in common with many of the lower animals; that the difference in their appearance is owing to the different work they have to perform.

The arm will therefore be studied in connection with the fore-limbs of animals. External resemblances and differences will be observed first, then more complicated details in structure, such as relate to bones, muscles, and joints. The different uses of the fore-limbs of animals, for locomotion and prehension, will be observed and associated with differences in structure, until finally, in a simple way, something of the wonderful structure of the hand and arm is perceived and its adaptation to a work of an entirely different character from that performed by any of the





lower animals. This fact perceived, the necessity of keeping the hands in the best possible condition will be easily inferred, and directions for doing so will be practically applied.

For the sake of economy in space the suggestions relating to the care of the body will, in every chapter, be given at the close under one heading, "Primary and Intermediate."

To aid the teacher the following special suggestions are given :

Make large outline drawings of the fore-limbs of animals, or collect pictures of the same and mount them on manilla paper.

Strive to be a model for the pupils in all that pertains to the care and cleanliness of the hands and nails. In the motion songs the movements of the teacher should be as nearly perfect as possible.

Commend the pupils occasionally, as a class, for the clean and therefore beautiful appearance of the hands in the exercises, but *never* call attention to an awkward movement made by any child.

PRIMARY.

THE ARM, FORE-LIMBS OF ANIMALS, AND THEIR USE.

Observe the human arm ; the length, size, shape, and position as compared with the lower limbs ; the hand in which it ends ; its general use—for head purposes, never for support or locomotion. Sketch the arm.

Find the picture of an animal that has a member corresponding very closely to the arm of man. Observe its length as compared with the lower limbs ; the fingers and thumb ; the use of the ape's arm in walking, climbing, seizing, and bringing its food to its mouth.

Observe the horse and find the part corresponding to the arm. Observe the size, shape, strength; the hoof in which

it ends; the position of the fore-limbs underneath and supporting the trunk ; their use for support and locomotion, and their adaptation to this use. Make a sketch of the fore-limbs of the horse, and enter a statement in regard to their use.

Observe the fore-limbs of the dog in the same manner ; how they are used, not only for support and locomotion, but for securing prey and bringing it to the mouth ; how the toes and claws are adapted to this work. Make a sketch of the fore-limbs, and enter appropriate statements.

Observe the long fore-limbs of the bat; the very long fingers ; the web uniting the fingers and arm with the rest of the body ; the claws with which one or two of the fingers are provided; the use of the fore-limbs. Make a sketch and enter statement.

Find the picture of an animal whose fore-limbs form swimming-paddles. Observe their length; the five webbed toes. Determine whether the fore-limbs of the seal are better adapted to water or to land.

Observe the wing of the bird—lightness ; shape ; size in different birds—how in some it is small and undeveloped as in the ostrich (show picture), long and pointed as in the gulls, large and strong as in the eagle and hawk, short as in the fowl—in all suited to its work of rapid, powerful, long or short flight. Sketch a wing and enter a statement in regard to its being fitted only for flight.

Observe the fish and find the part corresponding to the arms. Observe its position just back of the head; size; shape; motion; use. Make a sketch of the fin.

EXTERNAL PARTS OF THE ARM AND FORE-LIMBS.

Discover the parts of the arm and hand.

Apply the common name to each part—shoulder, arm, elbow, forearm, wrist, hand, back of the hand, palm, fin-

gers (fore, middle, ring, and little), thumb, ball of the thumb, tips of the fingers, knuckles, nails.

Make a sketch of the arm in the blank book indicating the common name of each part.

Observe the fore-limb of the horse and find the parts corresponding to the parts of the arm. Observe how near the trunk the elbow is located; how the forearm apparently forms the upper half of the fore-limb; how the wrist corresponds to the joint in the middle of the leg; how it bends forward. Observe the length of the part corresponding to the hand; the joints above the hoof corresponding to the joints of the fingers; and the ending in a single hoof instead of five fingers. Make a sketch indicating these parts. Observe the cow; cat, dog, mouse, squirrel, rabbit, frog, and other familiar animals in the same manner, finding the parts corresponding to the parts of the arm. Compare the length of the fore-limbs with that of the hind-limbs. Compare the number of toes on the fore-limbs with the number on the hind-limbs, observing that they are equal in the cow; that there are five on the fore-limbs and four on the hind-limbs of the cat, dog, and rabbit; that this order is reversed in the mouse and the frog. Observe the difference between the claws of the cat and the dog. Observe whether all these animals walk upon the part corresponding to the fingers.

Observe the wing of a bird or fowl and find the part corresponding to the hand; the forearm; the arm. Name the first bend or angle of the wing; the second; the third.

Observe the fin of the fish and find the parts corresponding to the fingers.

Show by sketches five different ways in which the fore-limbs end.

Model in clay the arm, and fore-limbs of some of the animals observed. Tell stories in number based upon the observations made.

INTERMEDIATE.

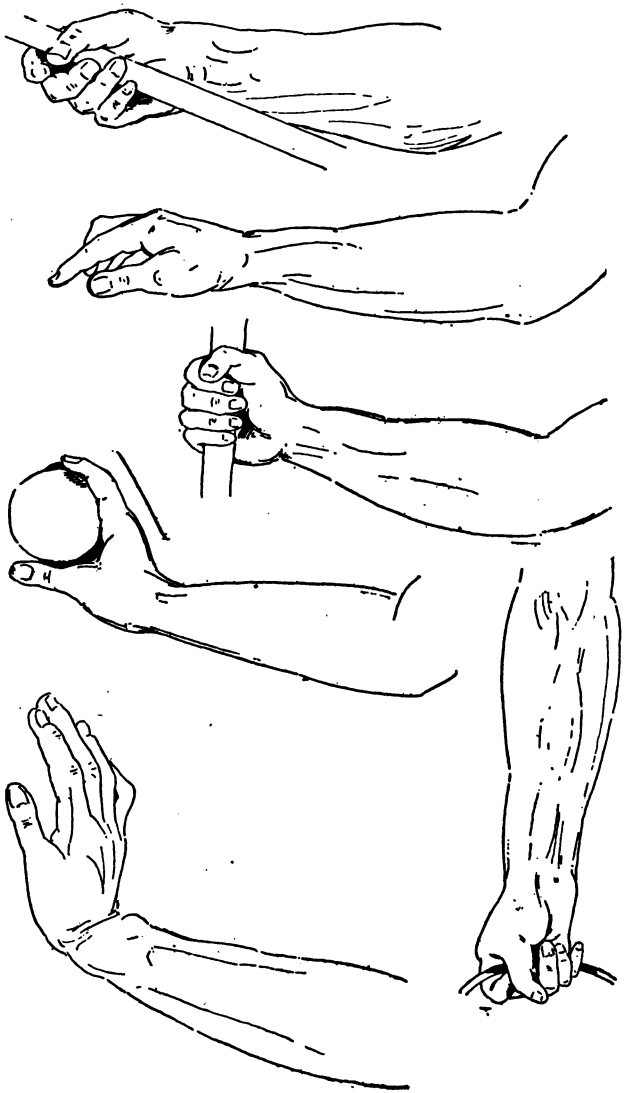
INTERNAL STRUCTURE.

Use.—Discover many of the ways in which the arms and hands are used—touching, grasping, throwing, lifting, pulling, pushing, etc.

Illustrate some of these movements by outline drawings. Perform some of the most common acts, such as picking up a book, writing on the board, sewing, etc., and determine which of the preceding movements are used in these acts. Observe the work done by the fore-limbs of animals. (See Hooker's Child's Book of Nature, Part II., Chapters on "The Hand" and "The Tools of Animals.") Determine whether man or the lower animals can make the greater variety of movements.

Associate the difference in length, strength, and shape of the fore-limbs with the difference in work. Observe the parts of the arm more closely and determine why it is capable of so many movements.

Muscles.—Obtain a fore-limb of an animal at the market



and review the points taught on muscles in previous lessons—the arrangement, shape, tendons, and attachment of the muscles.

Judging from the variety of movements of which the arm is capable, determine something in regard to the number of muscles attached to the arm, and, in a general way, locate the attachment of muscles causing certain movements—as movement of the arm across the chest, outward from the body, upward, forward, etc.

Observe that the muscles of the forearm are not so thick as those of the arm. Locate the attachment of the muscles causing the movement of the forearm. Teach the name and meaning of these two muscles—"biceps" and "triceps." Observe the swiftness with which the forearm can move.

Place the fingers of one hand upon the wrist of the opposite arm. Move the hand and fingers of the latter and observe the movement of the cords or tendons in the wrist. Hold the palm of the hand in the same way and move the fingers. Locate the muscles that move the hand and the fingers.

Determine the advantage of having the fleshy parts of the muscles in the forearm and only small cords in the wrist and hand.

Show from the picture on the chart the arrangement of the muscles of the human arm and hand.

Observe the fore-limbs of animals and determine whether the arrangement of the muscles is similar; why the fleshy parts of the muscles are on the upper part of the limbs; whether the lower animals use more or less muscles than man, in the fore-limbs.

Joints. — Discover many of the movements of the shoulder-joint. Observe whether any other joint in the body can move as freely as this one. Observe the two

movements of the elbow—bending and straightening. Hold the elbow, and observe that the rotary movement of the forearm does not take place at the elbow. Compare the movements of the elbow with those of the shoulder-joint. Observe the wrist and its beautiful curve. Determine whether it is made by the joining of two bones or of several. Discover the movements of the wrist—down and back, up and back, out and back, etc.

Discover the movements of the joints of the fingers—the slight movement down and back of the first joint, and the conditions under which it moves; the same movement, only more free, of the second joint; the nine movements of the third joint—down and back, up and back, to the right and back, to the left and back, and rotary. Apply the proper name—"ball and socket" or "hinge," to all the joints of the arm. Observe the fore-limbs of the horse, cat, or dog. Find the joints corresponding to the shoulder, elbow, wrist, and finger joints. Discover whether they move as freely as man's and in as many directions.

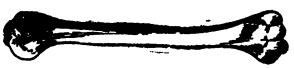
Bones.—Determine a third essential in structure in the movement of the fore-limbs, viz., the bones. Refer again to the advantage of possessing them, especially in the fore-limbs.

Observe the arm, and find the longest and strongest bone in it.

Obtain a specimen corresponding to this bone from the market. Observe its shape, the difference in the structure of the two ends, and the meaning of the difference. Show a longitudinal section of the bone.

Observe the difference in the structure of the shaft and the joints and determine the meaning of the difference.

Show a human specimen of this bone, if possible. Compare in size and shape with the one from an animal. Sketch the specimen.



Feel of the collar-bone, and the shoulder-blade to which the arm-bone and collar-bone are attached. Determine their use. Show specimens of these bones.

Clasp the fingers and thumb around the forearm. Move the forearm back and forth in a rotary direction. Discover whether there are one or two bones in the forearm, and which is the more freely movable.

Observe specimens of the bones of the human forearm; their relative size; how they move one upon the other; the back of the human hand being now up and now down. Observe these bones in their relation to other bones in the skeleton of the arm; how both join with the arm bone and only the larger bone on the thumb side unites with the wrist.

(If the skeleton is gradually presented in this manner, in sections, it is an object of interest to the children, and there is nothing repulsive associated with it. They realize that it is something that meets an important need in the body, and they become eager to know about its structure.)

Observe the curve in the wrist. Count the bones in the picture of the skeleton of the arm that produce this curve.

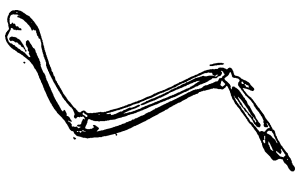
Count the bones in the hand. Observe the same in the picture on the chart. Count the bones in the fingers and thumb. Consider the advantage of having so many bones in the fingers.

Prepare the skeleton of the fore-limb of a small animal obtained at the market and the bones of the wing of a fowl. (See p. 17.)

After studying human bones and the bones of one or two of the lower animals, pictures or diagrams of the skele-

tons of the fore-limbs of animals will be interesting and instructive to the pupils. Compare them bone for bone with the arm.

In the picture of the skeleton of the fore-limb of the horse observe the bone corresponding to the arm-bone, its length compared with the other bones of the fore-limb; the elbow and direction in which it bends; the two bones corresponding to the bones of the forearm—their relative size, whether separate or attached to each other throughout their length; the five bones of the wrist or joint in the middle of the leg; the long bone (canon-bone) corresponding to the bones of the hand; the three joints of the single finger ending in a hoof.



Observe the lightness of the bones of the wing; their hollow structure; the large bone of the arm; the two bones of the forearm; the two long bones of the wrist; the bones forming the hand; the two fingers and the thumb.

The resemblance between the fore-limbs of animals is more strikingly illustrated in the skeletons than by any other means. Observe this resemblance in the bones of the arm of the monkey.

Sum up the advantages of the human arm—the number of joints; the variety of ways in which they can move; the number of trained muscles; the rotation of the forearm; the slender, flexible fingers; the position of the thumb opposing the fingers.

PRIMARY AND INTERMEDIATE.

CARE OF THE HANDS.

Determine the condition in which the hands should be kept in order that they may do their best work—strong, clean, soft, sensitive, flexible.

Name kinds of work that require strong, firm hands. Determine how they are made so—the healthful condition of the entire body; the necessity of exercising the muscles of the arm and hand.

Name kinds of work that require sensitive, flexible hands; skilful hands. Determine how the hands are kept in this condition—the condition of the skin, muscles, and joints; the need of care, exercise, and training; of abstinence from tobacco and alcoholic drinks that oftentimes rob the hand of its cunning.

CLEANLINESS.

Determine that cleanliness is one of the first essentials in the care of the hands.

Give the pupils plain, minute directions in regard to the care of the hands and nails.

Name some of the occasions when the hand should be washed—on rising and retiring; before eating; before preparing food; after working or playing; after travelling; after being with the sick; after shaking hands with many people; etc. Lead the pupils to form the habit of plunging the hands into water and thoroughly drying them before attempting any kind of work—an act that should be performed for the sake of the rest and refreshment it affords, if not for the sake of cleanliness.

With the aid of the pupils formulate simple directions for keeping the hands clean, something like the following: If the hands are rough and grimy, wash them in lukewarm water to which a little ammonia has been added.

Use good soap; rinse thoroughly. At bedtime wash the hands in water to which a little oatmeal has been added. Or, after washing and drying the hands thoroughly, rub them in dry oatmeal.

Determine the proper time and place for caring for the nails. Formulate simple directions in regard to their care, e. g., soak the fingers in warm water several times a week and carefully push back the skin from the nails; cut the free edge the proper shape and polish the nails with a chamois pad or on the "cushion" in the palm of the hand.

Consider the effect of cigarette-smoking on the appearance of the tips of the fingers and the nails.

Consider the necessity of wearing gloves, not for the sake of fashion, but for the protection of the hand, that it may be kept soft, sensitive, and flexible.

Train pupils to the idea that work is never to be sacrificed for the sake of sparing the hands, but that in all their work they should not be ashamed to protect and care for the hand.

Train the pupils to see beauty in the rough, misshapen hands that have toiled unceasingly for others. Poems occur frequently in current literature relating to this topic. Clip and preserve them, and teach them to the pupils.

EXERCISE.

Train the pupils unconsciously to move the arms and hands easily and gracefully. Make every gesture a means of expressing some thought. Aim to have it as clear and as accurate a mode of expression as possible. Not ease, grace, or beauty should be in the minds of the pupils, but the idea of saying something by means of the hands and arms.

The only condition of the hands of which the pupils should be conscious is their cleanliness. Make their appearance in this respect the condition under which the class may participate in the songs and games.

Require many exercises that call for the action of the entire body as well as of the arms, hands, and fingers. There are no objections, however, to hand and finger exercises if they are used as a mode of expression in the songs and games adapted in every way to delight children.

Continue the work begun in the kindergarten, of imitating the movements of different animals, as the birds in flying, the fish in swimming, the spider in spinning.

Imitate the movements of the branches of different kinds of trees.

Imitate different movements of men at work. (The teacher will observe how these movements require not only exercise of the arms, but the harmonious action of the entire body), as sawing, chopping, swimming, rowing, hoisting, etc.

The names of some of the songs that are used in the lower grades in connection with this topic, and the books in which they are contained, are as follows: "The Merry Little Men," "Five Little Mice," "The Squirrel"—Mrs. Poulsson's Finger Plays, D. Lothrop Co., Boston; "The Little Hands" —Stories in Song by E. W. Emerson and Kate L. Burns, Oliver Ditson & Co.; "Finger Play," "Family Finger Play."—Kindergarten Chimes, by Kate Douglas Wiggin, Oliver Ditson & Co.; "Thumbkin Says I'll Dance," "Eight White Sheep," "Five Little Chickadees."—Songs and Games for Little Ones, by Gertrude Walker and Harriet S. Jenks, Oliver Ditson & Co.; Motion Songs for Public Schools, by Mabel S. Pray (one of the latest collections, adapted to both Primary and Intermediate Grades), D. C. Heath & Co., Boston. In Gymnastic Stories and Games by Rebecca Stoneroad, D. C. Heath & Co., stories are told by means of gymnastics and gestures. The Boston Normal School of Gymnastics also publish One Hundred Gymnastic Games.

GOOD-HEALTH CLUB.

The rules entered by each pupil in this leaflet will be only those that he is willing to try to follow. They may relate to the following:

1. The cleanliness and care of the hands.

2. The manner of caring for the nails; the time and place for so doing.

3. A willingness to protect the hand and keep it in a condition for doing its best work; a willingness, therefore, to abstain from those practices that rob the hand of its steadiness and skill.

CHAPTER III.

MEANS OF LOCOMOTION.—THE LEG.

Helpful Books.—Orton's Comparative Zoology, Bert's Primer of Scientific Knowledge, Hooker's Child's Book of Nature, Part II., Needham's Elementary Lessons in Zoology, Lindley's Health in the Home.

SUGGESTIONS IN METHODS.

Lead the pupils to observe moving objects—lifeless and alive; that only living animals, so far as the pupils can observe, have the power to move from place to place; the means by which they move; their variety of movements and the superiority of man over the lower animals in this last respect. Have the pupils observe the parts of the human leg; the use of each part; the relation between structure and use; some of the points of difference in the structure of the human leg and the corresponding part of some of the lower animals.

As the pupils observe the use of the leg and foot in standing, walking, running, jumping, etc., train them in the *right use* of these members—not only at the time of the recitation, but whenever the opportunity occurs.

Thus will the pupils be led to appreciate the "gift" that they possess in common with the lower animals, viz., the power of locomotion, and something of the adaptation of the instrument to its work. Hygienic teachings associated with these observations will awaken interest and prove far more effective than if they were given in an isolated manner.

PRIMARY.

MOTION.—LIFELESS OBJECTS.

Observe the clouds as they drift along or fly over the sky, and determine the force that moves them.

Observe the boat floating on the stream and determine why it moves.

Observe moving water and determine why it flows.

Observe the steam cars and the trolley, and determine what makes them move.

Continue the observation of the movement of lifeless objects and determine the cause of the movement.

Write statements describing what has been discovered, as "The wind moves the clouds," etc.

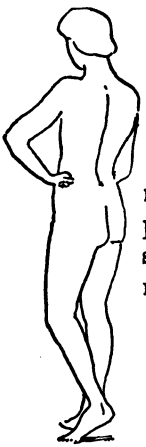
Notice that none of the objects observed was alive; that however great the object may be, if it is not alive, it cannot move of itself. Notice in this respect the superiority of the tiny insect over the locomotive.

MOTION FROM PLACE TO PLACE.—LIVE OBJECTS.

Observe all available forms of animal life and learn that they have the power to move from place to place or have had it.

Study comparatively the means of locomotion of animals, as legs, wings, fins, etc.

Give out to the pupils problems like the following:

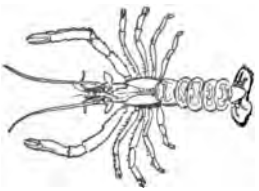


Find and sketch a form of animal life that moves from place to place by means of two legs, observing the usual organs of locomotion used by the bird.

Find and sketch a form of animal life that moves by means of four legs.

Find and sketch a form of animal life that moves by means of six legs, observing other organs of locomotion.

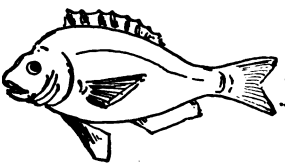
Find and sketch a form of animal life that moves by means of eight legs.



Find and sketch a form of animal life that moves by means of ten legs, observing other organs of locomotion, as the flapping abdomen and swimmerets of the lobster.

Find and sketch a form of animal life that moves by means of one foot.

Find a picture of a form of animal life that moves by means of thirty or more feet.



Find and sketch a form of animal life that moves by other members than legs or wings.

Find and sketch a form of animal life that moves by other means than legs, wings, or fins.

The pupils will not be able to find all these specimens in nature. After finding as many as possible, aid from the teacher in the way of pictures, sketches, and descriptions will be received with interest and will not make the pupils less observing in regard to the means of locomotion with which animals are provided.

Require the pupils to enter in blank books provided for the purpose, sketches and statements of the truths discovered.

VARIETY OF MOVEMENT.

Observe the movements of different animals.

Observe or recall the different movements of the horse, as walking, running, trotting, jumping, etc. Observe the different movements of the dog and the cat. Observe the difference in the shape of the hind limbs and fore limbs of animals that run swiftly. Observe the length of the hind limbs of animals that leap. Determine why the tortoise moves so slowly.

Observe the movements of birds; how birds of flight use their legs in hopping or walking, perching, and grasping; how those that remain on the earth use them more freely in running; how some use them mainly in paddling and are very awkward in movements on the land.

Observe how the crab moves sideways in either direction.

Observe the different movements a spider can make; a fly. Determine which of the two uses its legs more freely, and why.

Observe the movements of the earth-worm forward and backward.

Continue these observations until the pupils have discovered that the lower animals can make one, two, or more movements exceedingly well, but that, as a rule, they are limited in variety of movements.

Observe the movements that man can make—forward,

backward, to the right, to the left, creeping, walking, running, leaping, dancing, swimming, etc.

Instead of having the pupils name the movements of animals and man the following game may be played. One of the pupils is the leader, the others following him in the words and action. He sings to the tune, familiar in the kindergarten, "Oh, when I was a laddie, a laddie, a laddie!" inserting in place of the word "laddie" the name of the animal he wishes to personate, as the horse, pawing, the frog, leaping, etc. As he sings, "'Twas this way and that way," he imitates by movements of his arms, legs, or whole body, a certain movement of the animal. All the other pupils imitate him. Then from those who are able to name the animal, he beckons one to join him. They bow to each other and the first one retires from the centre and joins the circle. There is a desire on the part of each pupil not to let the game stop under his leadership owing to his failure to think of an action. Thus an almost endless variety of movements are discovered, especially when imitating the movements of man.

EXTERNAL PARTS OF THE LEG.

Discover some of the reasons why the human leg is capable of so many movements.

Observe the parts of the leg.

Teach the common name applied to each part—hip, thigh, knee, leg, shin, calf, ankle, foot.

Find the corresponding parts in the arm.

Observe the leg of the horse and of the bird and find the parts corresponding to the hip, thigh, knee, lower leg, ankle, and foot.

Observe the difference in the position and attachment of legs—in the horse, underneath and at right angles with the longest line of the trunk; in man, underneath and parallel with the longest line and supporting the trunk erect.

Observe how the legs of animals end—in feet, hoofs, toes, claws, etc.

Observe the human foot. Make outline drawings of it in different positions

Teach the common name applied to each part of the foot—sole, instep, arch, heel, ball, toes, joints, and nails.

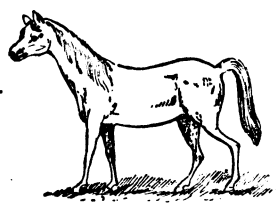
Observe the use of each part and compare with the corresponding part of the hand.

By means of pictures and objects discover whether the horse steps on its foot or the part corresponding to toes; the dog, the bird, the bear, the land-turtle, the crocodile, the monkey.

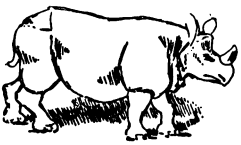
The last four named walk on their feet. Sketch their feet for the pupils.

Observe the number of toes on the feet of different animals.

Find and sketch a one-toed animal.

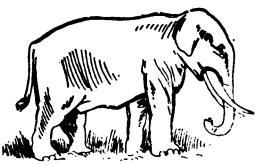


Find and sketch a two-toed animal.



Show the pupils a picture of a three-toed animal.

Show the pupils a picture of a four-toed animal.



Show the pupils a picture of a five-toed animal.

Make sketches of the feet of different animals and have the pupils name the animals from the feet.

Find the picture of a seal and observe how the legs turn backward and form swimming-paddles.

Observe the toes of the hen, duck, parrot, and eagle or hawk—the number of toes; their arrangement, size, strength, and talons; how the toes of the hen are adapted to life on the land and scratching for food; those of the duck to swimming; how the toes of the parrot are paired and adapted to climbing; and those of the eagle to seizing, holding, and tearing its prey.

Observe that the fly can walk upside down. Observe its foot with the naked eye. Show a microscopic specimen or a drawing of one. Observe the claws and pads. Tell the pupils of the fluid on the pads, by means of which the fly can stick to a surface.

Enter drawings of feet and statements of truths observed in blank-books.

Model in clay the legs of some of the animals observed.

Tell stories in number based upon the observations made.

From the large drawings made by the teacher, or from clipped pictures of the legs of different animals mounted on manila paper, name the animals to which the different members belong.

INTERMEDIATE.

INTERNAL STRUCTURE.

Joints. Refer to the many movements that the leg can make, and determine that one reason why it can do so is owing to the joints.

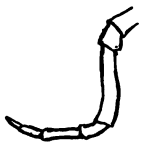
Count the joints in the human leg.

Apply the common name to them—hip, knee, ankle, and toe joints.

Observe by means of objects and pictures whether four-footed animals have the same number of joints in the leg that man has. Observe that the heel always bends backward and the knee forward; that the latter is often covered by the skin of the trunk.

Find forms of animal life that have no joints in the legs. (Distinguish between the true legs of the caterpillar that have joints and the pro-legs or prop-legs that have none.)

Find forms of animal life that have more joints in the legs than man has. Try to count the joints in the leg of a spider; fly; crab. Show the pupils drawings of the legs.



Discover some of the movements that the leg can make from the hip. Compare with the movements of the arm from the shoulder. Determine which joint moves more freely, the hip-joint or the shoulder-joint.

Observe the movements of the knee; how limited they are; compare them with the movements of the elbow. Compare the knee with the hip-joint. Name these two joints—"ball and socket" or "hinge."

Observe the movements of the ankle. Name the joint. Compare its movements with those of the wrist, and determine which of the two moves more freely.

Ask the pupils to observe, when retiring at night and their shoes are removed, the number of joints in each toe; whether they move freely; how each joint can move. Determine whether the lack of freedom of movement is owing to the structure of the joints or to the manner of dressing the feet. Apply the proper name to the joints of the toes.

Muscles.—Refer again to the movements made by the leg—running, walking, standing, dancing; the strength, grace, and skill shown in its movements. Determine that a second reason why the leg can make so many movements is owing to the fleshy parts or muscles, their number and their training.

Refer to the more limited number of movements made by animals; to the fleetness and strength of which their legs are capable; to the size and location of the muscles of the legs of animals noted for their swiftness of movement; to the location of muscles on the inside of insects' legs, and their great strength in proportion to their size.

As muscles in general have been considered under the first topic of the book, attention need be given here only to the muscles of the leg.

Remove the skin from the leg and foot of a fowl, exposing the muscles and tendons. Observe the arrangement of the muscles in layers; where the fleshy parts of the muscles are located; where the tendons are attached; how they pass over the joints. Pull the cords and move the toes. De-

termine the advantage of having tendons rather than the fleshy parts of the muscles in the fowl's foot.

Show a picture of the muscles of the human leg as illustrated on the chart. Observe the layers; where the muscles are the thickest; how the tendons pass over the joints, where they end, and the advantage of having them in the feet.

Locate the longest muscle in the leg; the strongest. Name the tendon in which the latter ends, "tendon of Achilles," and tell the myth associated with it.

Locate in a general way the following muscles — those that bend the toes; that straighten them; that bend the foot towards the leg; that straighten it; that bend the leg at the knee; that straighten it; that draw one leg across the other. Tell why one of the last is called the "Sartorius or Tailor's Muscle."

Refer to the arrangement of muscles in pairs—taught previously; how one opposes the other, one growing shorter and thicker when bending any part of the leg, while the opposite becomes longer and thinner.

Bones.—Refer again to the use of bones—taught under a preceding topic. Discover whether the bones of the leg and foot are larger, heavier, and stronger than those of the arm and hand, and why they are so.

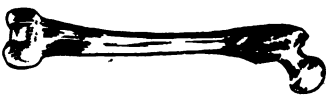
Observe whether the same is generally true in regard to the hind limbs and fore-limbs of animals.

Discover where the longest bone of the leg—and of the body—is located. Name it, "thigh-bone."

Observe four-footed animals and birds, and determine whether this is the longest bone in their legs.

From what is known of the movements of the hip-joint and knee-joint, determine whether the two ends of the thigh-bone are alike or not.

Get the thigh-bone of a lamb at the market or from the dinner-table, or use a human specimen if the school is provided with one. Observe its size and strength; its shape, the shaft and joints; the smooth but uneven surface of the joints, determining the reason for the points observed. Show a longitudinal section and observe the difference in the structure of the shaft and the joints.



Show a picture of the thigh-bone on the chart in its relation to the other bones. Sketch the thigh-bone. Compare it with the bone of the arm.

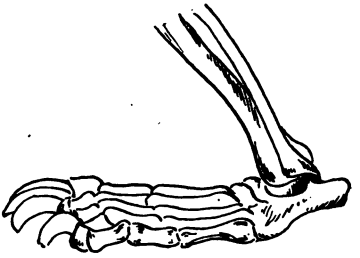
Observe the hip-bone—its strength and irregularity—and determine why it is strong and irregular.

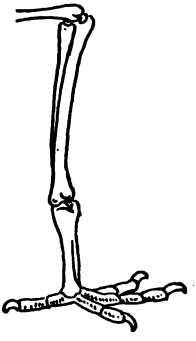
Feel the ridge of the shin-bone below the knee. Observe whether one or two bones can be felt. Show specimens of the two bones of the leg, also pictures on the chart. Observe their position; relation to each other; how the ends of the two form the internal and external ankles. Sketch the bones. Compare them with the bones of the forearm.

Show pictures of the skeletons of the legs of different animals—cow, bear, monkey, bird.

Observe whether these animals have two bones in the lower leg corresponding to those in man.

Observe on the chart the kneecap and determine its office.





Observe on the chart whether two or more bones form the ankle-joint. Compare with those of the wrist in number and size.

Observe the bones in the middle of the foot; how these with the ankle-bones form the arch of the foot; how the arch is supported by the bones of the heel and of the great toe. Explain the value of the arch and the care that is necessary in order to keep the arch strong.

Observe the bones of the toes—whether the toes all have the same number or not. Compare with the bones of the fingers in number and size. Determine the meaning of the differences.

PRIMARY AND INTERMEDIATE.

RIGHT USE—CARE AND TRAINING.

In all the lower grades, as pupils discover the *use* of the leg, call their attention to the *right use* of this member. Lead them to see the advantage of using it properly, and train them whenever opportunity occurs in performing properly the following simple acts that make up the bulk of all our activities.

Standing.—Position: Heels about four inches apart; toes pointing forward; knees straight; hips back; chest lifted; shoulders back and down; head erect; chin in; arms at the sides; weight of the body on the balls of the feet. Do not give little children the preceding directions. A request, such as, "Stand as tall as possible," is sufficient to lift the chest and head and throw the weight on the balls of the feet. Call

the attention of the pupils to the places and times when it is necessary to stand, the frequency of the act, the little fatigue occasioned if it is done properly, the relief afforded by rising frequently on the toes.

Walking.—Train pupils to stand properly, and special attention need not be directed to their manner of walking. There is no pleasure or grace in walking when one is conscious of the movement of the limbs.

Running. — For ordinary running, direct the pupils to hold the trunk and head erect, and close the mouth.

Jumping. — Position before jumping: Knees bent; trunk inclined forward. Position on landing: knees bent, rapidly flexing until the fall is broken; weight of the body on the balls of the feet, never on the heels.

Stooping.— Position : One foot in advance of the other; all the joints, from the toes to the shoulder, bent.

Rising from a Chair. —Position before rising: Trunk erect; right foot in advance of the left; right foot firmly planted, left foot raised at the

the attention of the pupils to the places and times when it is necessary to stand, the frequency of the act, the little fatigue occasioned if it is done properly, the relief afforded by rising frequently on the toes.

Walking.—Train pupils to stand properly, and special attention need not be directed to their manner of walking. There is no pleasure or grace in walking when one is conscious of the movement of the limbs.

Running. — For ordinary running, direct the pupils to hold the trunk and head erect, and close the mouth.

Jumping. — Position before jumping: Knees bent; trunk inclined forward. Position on landing: knees bent, rapidly flexing until the fall is broken; weight of the body on the balls of the feet, never on the heels.

Stooping.— Position : One foot in advance of the other; all the joints, from the toes to the shoulder, bent.

Rising from a Chair. —Position before rising: Trunk erect; right foot in advance of the left; right foot firmly planted, left foot raised at the

the attention of the pupils to the places and times when it is necessary to stand, the frequency of the act, the little fatigue occasioned if it is done properly, the relief afforded by rising frequently on the toes.

Walking.—Train pupils to stand properly, and special attention need not be directed to their manner of walking. There is no pleasure or grace in walking when one is conscious of the movement of the limbs.

Running. — For ordinary running, direct the pupils to hold the trunk and head erect, and close the mouth.

Jumping. — Position before jumping: Knees bent; trunk inclined forward. Position on landing: knees bent, rapidly flexing until the fall is broken; weight of the body on the balls of the feet, never on the heels.

Stooping.— Position : One foot in advance of the other; all the joints, from the toes to the shoulder, bent.

Rising from a Chair. —Position before rising: Trunk erect; right foot in advance of the left; right foot firmly planted, left foot raised at the

the attention of the pupils to the places and times when it is necessary to stand, the frequency of the act, the little fatigue occasioned if it is done properly, the relief afforded by rising frequently on the toes.

Walking.—Train pupils to stand properly, and special attention need not be directed to their manner of walking. There is no pleasure or grace in walking when one is conscious of the movement of the limbs.

Running. — For ordinary running, direct the pupils to hold the trunk and head erect, and close the mouth.

Jumping. — Position before jumping: Knees bent; trunk inclined forward. Position on landing: knees bent, rapidly flexing until the fall is broken; weight of the body on the balls of the feet, never on the heels.

Stooping.— Position : One foot in advance of the other; all the joints, from the toes to the shoulder, bent.

Rising from a Chair. —Position before rising: Trunk erect; right foot in advance of the left; right foot firmly planted, left foot raised at the

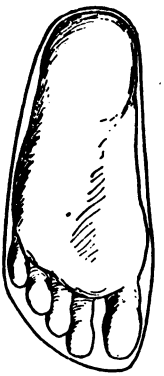
heel. Lift the body to a standing position by the action of the muscles and joints of the legs, keeping the trunk erect.

Mounting Stairs.— Position: head and trunk erect; legs moving as in walking; weight of the body on the balls of the feet.

Cleanliness.—Talk to the pupils as freely about the feet and the care of them, as about the hands. Consider the hard work required of the feet; their uncomfortable clothing; how they are deprived of air and oftentimes of water; how the little sewer pipes in the skin bring water and

worn-out matter to the surface and these are not allowed to escape; the uncomfortable, disagreeable, unhealthful results that follow. Emphasize, therefore, the need of frequent bathing.

Comfortable Shoes.—Consider how the shoes should be sufficiently loose to allow perfect freedom of movement; how they should be light and have flexible soles and broad heels; how they should fit the feet, the broadest part of the sole of the shoe being at the base of the toes, the inner side being in a straight line from the heel to the toe, the outer curving with the foot, the sole arched to fit the arch of the foot; why thin shoes, or those with cloth tops, are preferable; the circumstances under which thick heavy shoes are better; how, to sum up, the clothing of the feet should be such as to render them perfectly dry at all times, neither excessively hot nor cold, and allow perfect freedom of movement.



Exercise.—Follow the same general directions for physical exercise that are given under the topic, "The Arm." Nearly all of the books of songs mentioned there can be used in connection with this topic as well as with the others. "Swing Song," "Skating Song," and many others in Miss Pray's Motion Songs for Public Schools are very good for furnishing all-round exercise that tends to cultivate grace of movement. Train pupils not only in marching, but in walking, skipping, and fancy steps, changing quickly from one to the other, until control is gained over the body and it responds easily, gracefully, and unconsciously to whatever the mind wishes it to do.

GOOD-HEALTH CLUB.

The pupils will formulate rules relating to the following topics and enter them in their leaflets:

1. The movements in which the leg and foot play an important part, as standing, stooping, rising, etc.
2. Cleanliness and care of the feet.
3. The kind of shoes.

CHAPTER IV.

THE TRUNK.

Helpful Books.—The same as those mentioned under preceding topics.

SUGGESTIONS IN METHODS.

PRIMARY.

EXTERNAL FEATURES OF THE TRUNK.

Consider what the body needs in order to live. Watch the chest rise and fall as air is inhaled and exhaled, or "breathed in" and "breathed out." Listen to the beating of the heart as it sends the blood all over the body. Notice that the food is received into the trunk.

Refer to the care and protection which are given to valuable things—so with the organs that supply the body its needs, they are carefully protected.

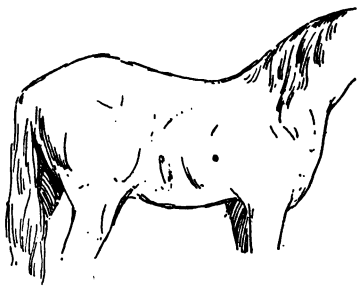
Determine that the function of the trunk is to hold and protect the organs that support life.

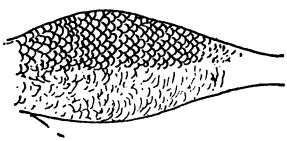
Observe the shape of the human trunk. Compare its size with the size of the other parts. Make an outline sketch of the trunk

Observe its position. Find reasons for calling it the trunk.

Observe the trunks of four-footed animals; their position, size, and shape; the curves in the trunk of the horse, their absence in the cow and sheep; the large size of the trunks of animals that chew the cud. Make an outline sketch of the trunk of a four-footed animal.

Name the different parts of the trunk—chest, abdomen, breast, back, shoulders, sides, waist, and hips.





Show how the trunk is divided into two parts—the chest and abdomen. Refer to these parts as first and second "stories" in the "House Beautiful." Tell how they are separated by an air-tight partition, of which there is no trace on the outside. Show on the human body about where this partition (diaphragm) is located.

Observe how distinct the two parts are in insects; which part bears the legs; whether both parts are movable.

Feel of the thorax. Observe the curved ribs and the bones to which they are united in the front and back. Observe whether the front part of the trunks of animals is protected by bones or not.

Locate and name the organs protected by this bony cage.

Observe the firmness of the walls of the thorax; how the thorax is able to change its shape; whether it is larger at the top or bottom.

Consider whether it would be well to reverse the shape of the thorax, as is often done by tight clothing.

Observe the soft yielding walls of the abdomen. Name and locate the principal organs contained in it. Explain why bony walls are not necessary.

Observe how the trunk is held erect and the head supported by the bony structure extending the entire length of the back. Deduce the term "column."

Bend the trunk in many directions and discover whether the back-bone can bend in one or in many places; whether it is made up of one or of many bones.

Feel the ridges of these bones down the back. Observe them on animals. Name them spines. Deduce the term "spinal column."

Find animals that have more flexible trunks than man has. Find those that have less flexible ones.

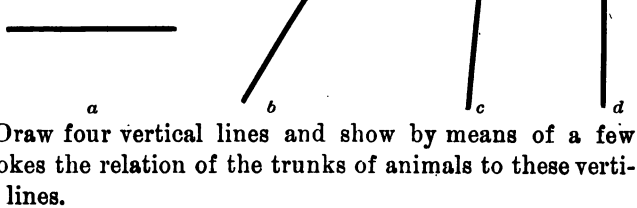
Name animals that never hold the trunk erect.

Name animals that hold the trunk partially erect.

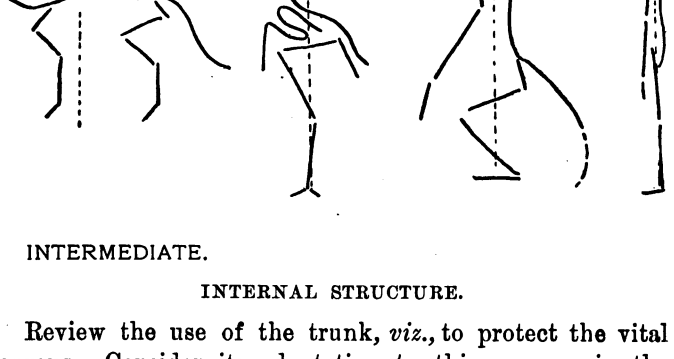
Name animals that can hold the trunk almost, if not quite, erect for a short time.

Name animals that can hold the trunk perfectly erect. Consider how man alone can keep the upright position, and how it should be kept at all times.

Draw straight lines showing the direction of the longest diameter of the trunks of the animals named.



Draw four vertical lines and show by means of a few strokes the relation of the trunks of animals to these vertical lines.

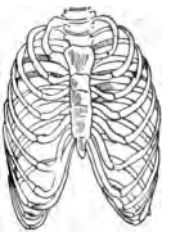


INTERMEDIATE.

INTERNAL STRUCTURE.

Review the use of the trunk, *viz.*, to protect the vital organs. Consider its adaptation to this purpose in the strength and shape of the thorax, the flexibility of the walls of the abdomen, the broad, firm floor of the pelvis, and the strong, elastic spinal column.

Give the pupils a more vivid idea of these features by showing specimens and entering more into the details of structure.



Bones.—Observe the bony cage forming the framework of the human thorax.

Show a prepared specimen of the skeleton of the thorax, or chest, of some small animal.

Show a picture of the skeleton of the human thorax.

Count the ribs. Observe where they are the longest; how they are attached at the back; how they are attached in front—the first seven, the next three, the last two. Name the bone to which they are attached "breast bone."

Observe the downward slope of the ribs; the upward and downward movement of which they are capable in breathing.

Determine the advantage of the ribs ending in cartilage in front. Find out whether the floor of the thorax is movable or not. Discover three ways in which the chest may be made larger.

Show a prepared specimen of a spinal column of a small animal and a picture of a human spinal column.

Observe the curves in the latter—the number forward and the number backward. Show how grace and elasticity are imparted by the curves.

Count the bones in the spinal column. Observe where they are the largest.

Get from the market several vertebræ. Observe the

cushions or pads of cartilage between the separate bones and determine their value.

Examine a single bone. Observe the body, the processes, and the ring from which the processes project. Find out the function of the processes and ring.

Observe on the chart the strong triangular bone in which the spinal column ends; how it fits between the two strong hip-bones like the keystone of an arch, the three forming a strong bony floor on which the weight of the body rests and to which the legs are attached.

Find other forms of animal life that have a back-bone.

Find forms of animal life that have no back-bone.

Muscles.—Observe the trunk and determine whether the muscles of this part of the body are round or flat, thick or thin, large or small; whether few or many judging from the movements of the trunk.

Show on the chart how the muscles are arranged in layers. Locate in a general way those that produce certain motions, as those that draw the shoulders backward; the arms forward across the chest; the shoulders forward; that lift the ribs, etc.

Contents of the Trunk.—Show by means of the chart the organs of the chest and abdomen—their relative position and size. Refer briefly to their work and importance.

(For more thorough study of these organs, see chapters on Food and Air.)

Care of the Trunk.—Strive in every instance to impress upon the pupils' minds the work that every part of the body has to do; its structure as adapted to this end; the necessity of keeping all the parts in a healthful condition that they may do their important work in the best possible manner.

Make the pupils so familiar with the normal waist that a small, tapering one will be an offence to their sense of fitness and beauty.

Consider the necessity of wearing loose clothing—that the internal organs may have all the room for their growth and movement that they require; that the muscles of the trunk may be strong and well developed, able to support the trunk, and produce all the movements desired quickly and without fatigue.

Consider how the different parts of the trunk are to be carried—the chest lifted, the shoulders thrown backward and downward, the abdomen depressed.

Illustrate the proper pose of the human figure. Observe that a vertical line drawn from the centre of the head passes through the centre of the hip to the ball of the foot.

Give the command to the children to lift the chest and stand as tall as possible. By means of a long rod held vertically at the side test the pose of the children on different occasions.

Observe the directions given on exercise in the chapter on The Arm. Use the imitative exercises mentioned there, or similar ones, that call for the harmonious action of all parts of the body. See that the muscles of the waist, chest, and abdomen are exercised.

Bring to pass better health and better morals by inspiring children with a love for cleanliness. Impress upon their minds the necessity of the daily quick, all-over morning bath. With the bathing of the trunk comes the deep sense of refreshment that is not felt by washing simply the hands and face.

GOOD-HEALTH CLUB LEAFLET.

Formulate rules relating to the following:

1. Loose clothing.
2. Proper carriage.
3. The all-over bath.

CHAPTER V.

THE HEAD AND NECK.

Helpful Books.—The same as those mentioned under preceding topics.

Artists' books on drawing that contain pictures of the heads of animals and of different parts of the head, as eyes, ears, mouths, etc., will afford much help to the teacher in the comparative study of the external features of heads and necks.

Valuable articles relating to the care of the eyes, ears, and other parts of the head, written by specialists, appear from time to time in periodicals. These should be clipped by the teacher and preserved for reference.

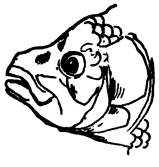
SUGGESTIONS IN METHODS.

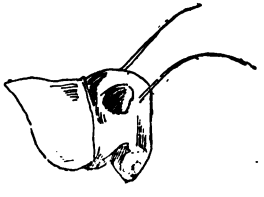
PRIMARY.

EXTERNAL FEATURES OF THE HEAD AND NECK.

The Head.—Observe the position of the human head; its relation to the other parts of the "House Beautiful." Call it the cupola or tower. Observe that it can turn in many directions. Observe its strong, dome-like roof; two windows in front for the admission of light; two gateways at the side by which sound enters; a porch in front guarding two circular ventilators for the admission of air; and a large folding-door through which all the food of the House passes.

Observe the importance of the head as a receiving office, not only of all those things that nourish the body, but of





all the knowledge that is being constantly gained. Consider the knowledge gained through the senses.

Have pupils observe how quickly they think; how many acts they are able to perform; the organs by which the acts are performed; how the mind tells the organs what to do.

Tell the pupils that the part of the body that is used by the mind in thinking and wishing and telling the other parts what to do is located in the head. Name this part the brain. Consider its importance and how it should be carefully protected.

Observe its protection by the hard, bony case.

Find other animals that have heads. Observe what they can do and the intelligence they show.

Find animals that have no heads. Observe how little they can do and how little they seem to know.

Observe the commanding position of the head in man.

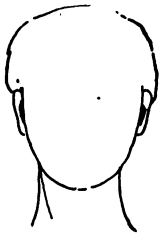
Observe its position in the lower animals—in the cow, the dog, the frog, and the bird.

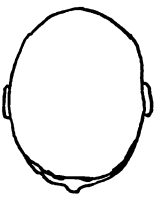
Draw straight lines showing the position of the head in relation to the trunk in the animals named and in man.

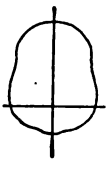
Observe the shape of the heads of different animals —that the surface is curved and the shape such as is best able to resist the force of blows.

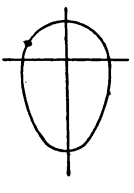
Observe the elliptical shape of the human head.

Make an outline sketch of the front, side, back, and top of the human head.









Outline the head of a child viewed from the front; the head of a grown person. Observe the broadest part in each.

Compare the shape of the human head with the shape of the heads of lower animals.

Point to the different parts of the head and name them —skull, face, crown, back, sides, scalp, hair, ears; parts of the face—forehead, temples, eyes, cheeks, nose, mouth, and chin.

Find the corresponding parts on the heads of animals.

Determine uses of the hair. Observe the two parts of a hair and name them "root" and "stem."

Find animals that have manes.

Observe the fur or plumage on the heads of animals and notice how it differs from that on other parts of the body.

(Other parts of the head will be studied under Organs of Special Sense.)

The Neck.—Discover ten or twelve movements that the head can make.

Determine how the head can move so freely—the advantage of a jointed neck.

Name and locate the different parts of the neck—throat, nape, sides.

Observe whether lower animals all have necks or not; how freely some of the animals can move their heads, as the bird, horse, etc.; how some cannot move the head at all, as the fish, crab, spider, etc. Notice the different shapes of necks, how some are long and slender, others short and thick; how the neck arches over in the horse and dips under in the cow; how some are round and others flat; how some are supplied with manes and others with dew-laps.

INTERMEDIATE.

INTERNAL STRUCTURE OF THE HEAD.

Bones.—Feel of the head and notice the hard, bony box covering the brain. Name it "the skull."

Observe its position—how it is nearly balanced on top of the spinal column.

Determine where it would be best to have the thickest part of the skull; where the thinnest; whether the smallest end of the oval is in front or at the back.

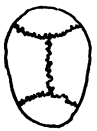
Feel of the head and notice whether any joints can be found in the skull. Find the only freely movable bone of the head.

Show the skull of a small animal, that the pupils may see the joints in the head.

Find out the name in carpentry of this method of joining.

Determine the advantage of joining the bones of the skull in this manner rather than of having one solid bone.

Trace on the heads of some of the pupils about where some of these joints are located.



Show the top of a skull or a picture of one.

Show a bone of the skull. Observe the structure of the bone—the thick, tough outside layer; the thin, hard, brittle inner layer; and the spongy layer between the two.

Write statements telling how the skull is adapted to protect the brain—in regard to its shape, the number of pieces and joints, and the structure of the bone.

Count the large openings in the skull. Name the organs of sense located in them. Observe the small holes in the bones. Find out the office of these holes.

Muscles.—Observe the human head and find where the muscles of the head are the thickest; where they are the thinnest.

Determine why the muscles of the neck and lower jaw are stronger than others on the head.

Determine whether the muscles at the back of the neck are stronger in man than in quadrupeds.

Name some of the muscles of the head not used by man that are used by animals.

Locate in a general way the following muscles: the one that lifts the eyebrows; that bends the head backward; that bends the head to the right; that lifts the corners of the mouth; that draws the corners of the mouth down.

Find a circular muscle on the face. Determine what it does. After studying the muscles of the head in this manner, show a picture of the muscles of the head on the chart.

Consider how the muscles of the face have quite a different work from those of other parts of the body, viz., in determining the expression of the face. As strength and quickness of movement can be cultivated by exercising the muscles of other parts of the body, so a gloomy, sad, cross expression, or a sunshiny, happy, pleasant one, may become a part of the face, according as the "cross muscles" or the "pleasant muscles" of the face are brought into constant action by corresponding thoughts.

CONTENTS OF THE HEAD.

Specimen.—Prepare beforehand a specimen of brain from a calf, sheep, or rabbit that may be obtained at the market. Ask the butcher to remove the skin and the muscles, and the top of the skull by sawing the bone in a

circular direction. If the bone is thin the top of the skull may be snipped away, little by little, with bone-nippers. Use a thin, blunt edge to separate the dura mater from the bone. Gently pass the handle of a scalpel under the brain and lift it from the skull. Place the specimen in 20 per cent. alcohol.

Speak of the brain in admiring terms, as of a jewel packed securely in a strong case. Call the attention of the pupils to its delicate, pinkish-gray color. Repulsion for specimens comes with later years and is largely the result of training. The children will feel only interest in these specimens if the teacher is truly interested in them.

The Brain.—Show a skull and tell the pupils how snugly the brain fits into the skull, filling all the little hollows and cavities.

Tell the pupils, or show them, if possible, how it is protected by three membranes—the thick, tough one lying next to the bone, the "durable mother" (*dura mater*); the thin, delicate one lying next to the brain, the "soft mother" (*pia mater*); and between the two the finest, most delicate one of all (*arachnoid*), named after a noted spinner of old, Arachne, who spun webs as fine as cobwebs. (Briefly relate the myth.)

Observe the great brain; the little brain; the bridge and bands connecting the several parts of the brain; and the spinal bulb by which the brain is connected with the spinal cord.

Show the pupils on the chart the great brain of man. Compare it in size with that of lower animals. Show where it is located in the human head. Tell the pupils something of its work.

Show where the little brain is located. Tell something of its special work.

Observe how the large brain is divided into two parts and the little brain is not.

Observe the wrinkled surface. Tell or show how the folds differ in different animals and explain their relation to intelligence.

Find out whether the brain is solid or hollow by cutting off a slice of the brain. Find out whether the cavities are connected or not.

Observe the difference in the color of the outside and the inside of the brain. Cut through the little brain and observe the structure called "arbor vitæ."

The Nerves.—Show how nerves are given off from the brain in pairs—how one pair goes to the eyes, another to the ears, etc., special messages being received over them by the brain. Count the pairs shown on the chart.

Observe the great main trunk connected with the brain.

Get at the market a portion of the spinal column and cord of a calf. Observe the protection of the cord, its size and color; how the nerves are given off from it in pairs. Show how these divide and subdivide until almost every part of the body is reached by nerves. Show a small muscle to which a nerve is attached. Consider the function of the nerves given off by the spinal cord, viz., to transmit messages from every part of the body to the cord and thence to the brain, and to carry orders from the brain to every part of the body.

Consider the importance of the brain and the nerves; the provision that nature has made for their nourishment and protection; the advantage of having a clear brain and steady nerves, and the kinds of work that demand such; the folly and danger of indulging in any habit that weakens the brain and nerves; the effect of tobacco and alcoholic drinks on the mind and morals.

PRIMARY AND INTERMEDIATE.

CARE OF THE EXTERNAL PARTS OF THE HEAD AND ITS CONTENTS.

Give the pupils plain, simple, specific directions in regard to the care of the external parts of the head. Having children repeat general statements in regard to the importance of cleanliness is not sufficient. No teacher should feel it beneath her to enter into details and tell pupils definitely how to care for the face and hair. Deduce with the pupils directions something like the following:

Care of the Face.—Bathe the face at least twice a day, on rising and on retiring. On rising, cold water applied with the hands to the face (as well as to the entire body) furnishes the right stimulant to the day's work. At night use warm water, a little soap of the best quality, a woollen washcloth in preference to a cotton one, and a soft towel.

Care of the Hair.—Consider with the pupils the necessity of washing the hair frequently; how it should be protected from dust whenever possible; the time and manner of brushing it daily—on retiring, with long, careful strokes, letting the brush penetrate to the scalp; the value of light, well-ventilated hats.

Deduce with the pupils definite directions for washing the hair, as: 1. Wet the hair thoroughly with warm water. 2. Rub the hair and scalp thoroughly with a solution of white castile soap and water. 3. Rinse with warm water first, gradually reducing the temperature until the water is quite cold. 4. Shampoo with a towel, and shake the hair over the shoulders in little strands until it is dry.

Care of the Brain and Nerves.—Consider with the pupils the conditions under which the brain and nerves will do their best work—how they must be supplied with proper food; how those things must be avoided that are especially injurious to the brain and nerves, as alcoholic drinks, to-

bacco, and other narcotics; the need of pure air at all times; the value of exercise of both body and mind; the necessity of rest and of sound, natural sleep.

GOOD-HEALTH CLUB LEAFLET.

Formulate rules relating to the care of the face and hair, and such other rules as have not already been incorporated in the leaflet that tend, if followed, to produce a sound brain and steady nerves.

CHAPTER VI.

ORGANS OF SPECIAL SENSE.—THE SKIN.

Helpful Books.—The same as those mentioned under preceding topics.

SUGGESTIONS IN METHODS.

PRIMARY.

Touch.—Close the eyes and describe articles from the sense of touch, with reference to their shape, surface, hardness, etc.

Estimate the weight of articles by lifting them.

Compare articles with reference to the preceding qualities.

Compare articles with reference to their temperature.

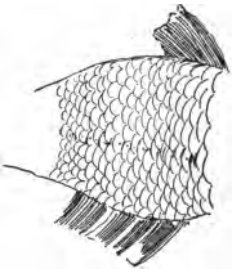
Consider how this knowledge is obtained and locate the sense of touch in the skin.

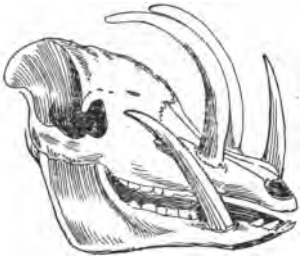
Consider the value of a delicate sense of touch, the kinds of work that require it, and the best means of keeping it delicate.

External Features of the Skin.—Observe the outer covering of man and determine other uses of the skin than that of affording a means to the sense of touch.

Observe its color and smoothness; how perfectly it fits the body and yields to every movement. Observe the wrinkles in the skin at the joints and tell why they are there.

Observe where the skin is the thickest and hardest and





determine why this is so. Observe where it is the thinnest.

Find three parts of the human body that belong to the skin, i.e., grow from it.

Compare the coverings of lower animals with the covering of man. Name animals that have fur, wool, quills, feathers, scales, shells. Determine the use of these coverings. Find out whether these animals have a true skin; whether they shed their coats of fur, wool, etc., and how often.

Find out in which season the fur of an animal is the longest, thickest, and most glossy. Find out how the fur of animals differs in cold and in hot climates.

Observe the plumage of birds—the difference in coloring; the different kinds of feathers on different parts of the body; the provision against their thorough wetting. Find out how the plumage differs in summer and in winter; when it is moulted.

Observe the coverings of fishes—how the overlapping scales of some form a coat of mail for protection; the adaptation of the covering to easy movement through the water.

Observe the coverings of an oyster, a scallop, and a clam—the protection afforded these animals in the color and strength of their shells; the beauty of the inner side of the shells. Find out whether the shells are ever shed.

Observe the coverings of crabs and lobsters—their color and toughness. Find out when and how these shells are shed.

Observe the covering of an insect—its hardness, smoothness, and oftentimes its beauty of coloring.

Name animals that shed their skin every year.

Tell the pupils how the skin of man is being renewed constantly.

Find out the parts that grow from the skin of animals,

such as horns, tusks, teeth, claws, hoofs, wings of insects, etc.

Observe which is the better protected by the covering, man or the lower animals, and determine why this is so.

Consider the need of clothing, and of different kinds in different seasons. (See Chapter on "Clothing.")

INTERMEDIATE.

INTERNAL STRUCTURE.

Recall the uses of the skin determined in the lower grades.

Use.—Continue the training of the sense of touch.

Find parts of the body most sensitive to touch. Apply blunt-pointed scissors to the skin on the back of the hand, tips of the fingers, arms, cheeks, and lips, and observe the separation of the two ends of the scissors that is necessary in order to perceive both of the ends.

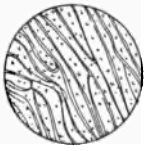
Hold a warm body near parts of the face, hands, and arms and determine where the sense of heat is most delicate. Hold a piece of ice in the same manner and make an inference.

Discover another use of the skin. Observe the perspiration on the skin on a warm day or after exercising. Determine the benefit this is to the body—how by evaporation of moisture from the skin the body is cooled. (See Chapter on "Water.")

Find out how the perspiration is brought to the surface.

Scarf Skin and True Skin.—Study the structure of the skin. By means of a pin remove a little of the outer layer. Notice that there is no pain in removing it. Compare its color with that of the under layer. Determine which layer contains the blood and nerves. Name these two layers. Examine the skin of the hand and notice if any tiny openings or pores can be seen. Examine the skin of

the nose and at the edges of the eye-lids in the same manner.



Show the pupils a microscopic specimen of the surface of the skin, or a drawing of a specimen. Observe the minute holes. Describe them as the openings of little tubes extending into the skin.

Show a microscopic specimen of a longitudinal section of the skin. Observe the outer and the inner layer; the coloring matter that gives the different color to the skin of different races; the sweat-tubes coiled into knots and the oil-tubes or glands that open on the surface. Observe the difference in the shape of the two. Find out where the sweat-tubes or glands are most numerous; the oil-glands; the work done by each, i.e., the material brought by them to the surface; the quantity of water thrown off from the body in perspiration in a day.

Consider the activity of these millions of little tubes and their necessity to the health of the body. Compare their work to the drainage of a house and consider how important it is that the pipes be kept open and clean.

Determine the condition of the skin and the openings of the tubes after oil, water, and solid waste material have been deposited on the surface for twenty-four hours.

Consider reasons why the bath is necessary—for the sake of health, comfort, and enjoyment; that the sense of touch may be kept delicate; that beauty may be preserved; that the respect of self and of others may be maintained.

PRIMARY AND INTERMEDIATE.

Care of the Skin.—In teaching this topic another opportunity is afforded for creating in the pupils' minds a desire for cleanliness. Lead pupils to see that only as the skin is kept clean will it serve all its purposes well.

Consider in a plain, simple, direct manner all the necessary details pertaining to the bath. Some of these are: The kinds of baths—warm, 90° to 96°; tepid, 75° to 90°; cold, 50° to 75°; the class of people to which each kind is adapted; the best time to take the bath—the number of hours after and before eating; the value of the quick morning bath; the condition of the body; the temperature of the bath-room; the use and kind of soap, sponge, and towel.

Consider other essentials to a beautiful skin, as pure air, sunshine, exercise, and nourishing food.

GOOD-HEALTH CLUB LEAFLET.

Formulate a rule relating to the bath.

CHAPTER VII.

THE MOUTH.

The comparative study of the structure of the mouth is included under Foods, Digestion, etc., and will not be repeated here.

TASTE.

Close the eyes and name articles of food from the sense of taste.

Locate in a general way the sense of taste.

Observe the appearance of the surface of different parts of the tongue.

Place a drop of vinegar upon the tongue and watch the effect.

Find which part of the tongue is most sensitive to sweet and bitter substances; which part to salt and sour substances.

Close the eyes and pinch the nose tightly and try to name, by tasting, different spices, coffee, apple, onion, turnip. Make an inference from this experiment in regard to the influence of smell upon taste.

Determine the purpose of taste.

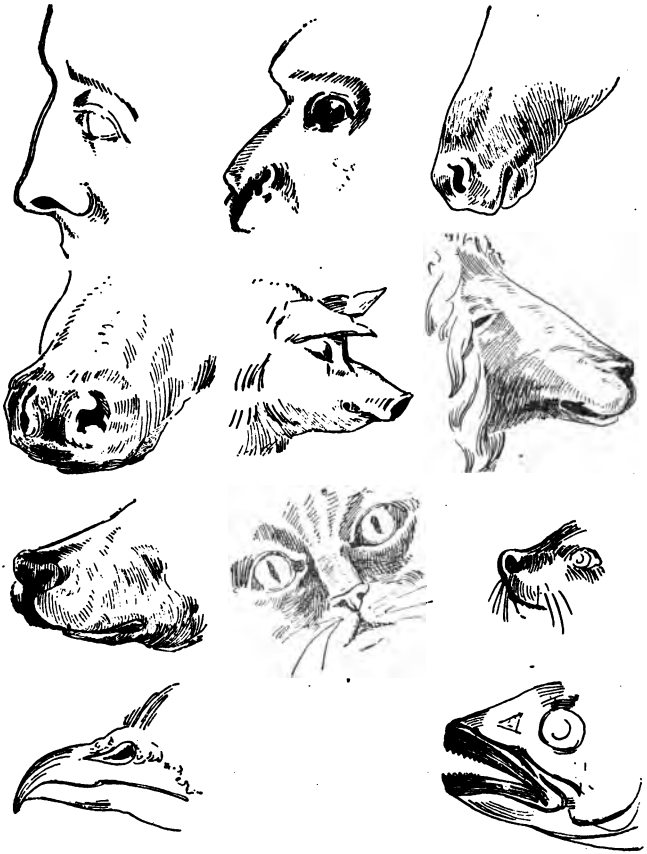
Observe the manner in which fishes and birds eat, and determine whether their sense of taste is delicate or not.

Observe higher animals in the same manner.

Determine the conditions necessary in order to taste—the dissolving of food and bringing it in contact with the mouth.

Consider the pleasure derived from a delicate sense of taste.

Consider the effect of alcholic drinks, tobacco, mustard, and spices upon the sense of taste.



CHAPTER VIII.

THE NOSE.

Helpful Books.—The same as those mentioned under preceding topics.

SUGGESTIONS IN METHODS.

PRIMARY.

SMELL.

Close the eyes and name objects from their odor, as flowers, fruits, herbs, spices, perfumes, etc.

Observe the odors in the air at different seasons of the year—in the spring, the odors from the starting vegetation, the newly-turned soil, the blossoms of the fruit-trees ; in the summer, from grain and corn fields, clover, new-mown hay, flowers, fruit, etc.; in the fall, the odors from dying leaves, fall flowers and fruits; in the winter, the invigorating odor that accompanies frost.

Train children to perceive and enjoy the odors from the fields, woods, seaside, mountains, and of the fresh, sunshiny air that pours into their rooms and greets them every morning. Make them appreciate delightful odors, so that on entering cars, halls, churches, school-rooms, or their own homes, if offensive or injurious odors are present, they will be detected by the children at once.

Determine the use of the sense of smell—to warn, to afford pleasure, and to furnish knowledge.

EXTERNAL FEATURES OF THE NOSE.

Observe the human nose—its shape and position. Sketch an outline of the nose. Feel of it and determine whether it has a bony framework and where it is located. Observe whether the nose is movable.

Name the different parts of the nose—upper part, lower part, tip, sides, bridge, and nostrils.

Observe the important use of the nose in breathing.

Compare the human nose with the noses of some of the lower animals.

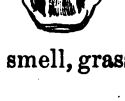
Observe whether all animals have a nose. Find some that do not have a nose.

Observe the nose of a horse; a cow; a pig; a goat; a cat; different kinds of dogs; a seal; a bird. Observe in each case whether it has the same position with reference to the mouth that it has in man. Determine a reason for the nose being so placed. Determine why the nostrils of the seal are so high on its head. Observe how the noses of different animals differ in shape—the difference in the curve of the bridges of noses.

Find a picture of an animal whose nose moves freely. Find out all the uses of this nose.

Observe how the nostrils of different animals differ in size, shape, and distance apart.

Find animals whose nostrils are round; ovoid; kidney-shaped.



Observe whether the fish has nostrils, and if so, their number and position.

Relate incidents that show that the dog has an acute sense of smell; the cat; the fly.

Discover which have the more acute sense of smell, grass-

eating or flesh-eating animals; fishes or birds; man or the lower animals.

Determine in what respect this sense is superior in man.

INTERMEDIATE.

INTERNAL STRUCTURE.

Review the external features of the nose and its use in breathing and smelling.

Observe the two cavities to which the nostrils form the entrance; the hairs and their use; the lining, its color and moisture.

Show a diagram or a sketch of the internal structure of the nose. Observe how the hard and the soft palate form the floor of the nose; how the cavities open into the upper part of the throat.

Observe the bony framework of the nose—the bones forming the bridge, the sides, and the partition. Describe and sketch for the pupils the scroll-like bones projecting from the sides of the nose; the winding passages formed by them through which air and the particles of substances that affect the sense of smell pass.

Show how the bones are perforated by holes in many places for the passage of nerves that carry the special message of smell to the brain.

Feel of the tip of the nose and the lower part of the partition and determine the substance forming these parts.

Locate some of the muscles by which the nose is moved.

Show how the structure of the nose is adapted to its two uses, *viz.*, the passage of air through the nostrils and smelling, determining the use of the various parts, the hairs, the moisture, the winding passages, etc.

Determine whether all odors can be detected by ordinary inhaling—the special effort that is necessary sometimes; the part of the nose in which the sense of smell is located.

Trace the act of smelling from the substance to the brain—the floating of particles of the substance in the air, their coming in contact with the moist lining of the nose and affecting the nerves that make the odor known to the brain and mind.

PRIMARY AND INTERMEDIATE.

CARE OF THE NOSE.

Consider with the pupils the importance of keeping the nose in a healthy condition, that it may do its double duty. In this connection consider the following topics: The necessity of perfect cleanliness as a preventive of catarrhal troubles; the necessity of breathing pure, moist air; the necessity of abstaining from snuff-taking and smoking; the importance of forming the habit of breathing through the nose; the value of an acute sense of smell.

Give the pupils vocal exercises, such as dwelling on the sounds *m, n, ng* that tend to strengthen the nasal passages.

GOOD-HEALTH CLUB LEAFLET.

Formulate rules relating to breathing through the nose and abstaining from the use of those things that would injure the sense of smell.

CHAPTER IX.

THE EAR.

Helpful Books.—The same as those mentioned under preceding topics, and, in addition, any standard work on elementary physics.

SUGGESTIONS IN METHODS.

PRIMARY.

HEARING.

Observe different sounds that may be heard in the school-room at different hours of the day.

Observe and report sounds heard on the way to school in the morning; in the early morning on rising; at noon-time; in the evening.

Recognize birds, insects, and other animals by the sounds they make.

Listen to the sounds made by the wind and the water. Describe them.

No attempt is made in the primary grades to teach anything of the vibratory movement of air and its relation to the mind. It is thought sufficient to train young pupils to observe, distinguish, and enjoy sounds, and to observe in different animals the external part of the organ by means of which sounds are heard.

Cultivate quickness and accuracy of hearing. Name objects from the sounds made by tapping on them; name materials from the rustling sounds produced by them; name people from their voice, laugh, and step; distinguish

different accents and inflections in reading and speaking; different musical tones, and different qualities of sound, as rough, shrill, etc.; judge of the location of objects from the sounds produced by them.

Observe the sounds made by insects, birds, and other animals, by wind, water, leaves, branches, etc., and keep a list of the sounds heard and identified day by day.

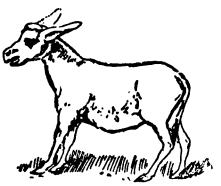
THE OUTER EAR.

Refer to the many sounds that have been noticed; how the air is full of them and they seem to be rushing about in every direction like little fairies. Imagine them beating upon all parts of the body, but to no effect until they enter the gateways at the sides of the head and knock at the doors made especially for them. Observe the outer ear, how it projects from the head, in order that these sounds may be caught more easily; how we sometimes assist it in its work by putting the hand behind the ear.

Observe the shape of the outer ear; position; attachment. Feel of it and notice whether there are bones in it; whether it is movable.

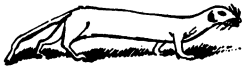
Observe the opening into the canal; the hairs that guard the entrance; the wax. Find out the use of the wax and the hairs.

Compare the human ear with the ears of lower animals.



Find an animal, or the picture of one, that has large, movable ears.

Find an animal, or the picture of one, that has long, pointed ears. Observe how they move or turn.



Find an animal or the picture of one that has small, round ears.

Find an animal, or the picture of one, that has large, drooping ears.

Find an animal, or the picture of one, that has short stiff ears.

Find out which of the animals observed have the most acute hearing.

Observe whether the sparrow or the robin has an outer ear; the chicken; the owl; the frog; the fish; the insect.

Observe the position of the outer ear in different animals —on the top or the sides of the head.

Observe the cow and the horse. Show by a sketch the position and direction of the outer ears of animals that have horns and of those that have no horns.

Observe how the ears of the horse open; how they turn. Find out whether one ear can turn in one direction and the other in another direction at the same time. Observe the position of the horse's ears when it is quiet, when it is startled and listening, and when it is mad.

Show pupils a snail or a clam and the base of its foot and tell them how the sense of hearing has been found located

in that part of the body. Tell them of the peculiar location of the sense of hearing in other animals, as in the fore-legs of some grasshoppers, on the first ring of the abdomen in locusts, at the base of the antennae in crabs and lobsters.

Relate incidents proving that animals have acute hearing. Determine whether man can hear as quickly or at so great a distance as some of the lower animals; that man can distinguish many sounds and animals very few.

INTERMEDIATE.

VIBRATORY MOVEMENT.

Observe each experiment, describe the apparatus, tell what was done with it and the result in each case. Make a record of the experiment.

Observe the vibration of objects. Stretch a string or a wire and cause it to vibrate. Watch the vibration of violin strings. Describe the movement. Name it "vibration."

Prove that musical instruments and other bodies giving forth sounds vibrate. Strike a large bell. Observe the edge of the bell. Strike a tuning-fork and hold it near the surface of a glass of water. Observe the effect and describe it. Watch the wires of a piano as some one strikes the keys. Observe other musical instruments and determine the parts that vibrate and produce sound.

Determine that solids conduct sound. Place the ear at one end of a long table; tap very gently with a pin on the opposite end. Observe the distinctness with which the sound is heard. Perform other familiar experiments. Explain why the Indians listen for the approach of the enemy and boys for the approach of a distant train by lying down with the ear to the ground. Make a toy telephone. Discover why low tones or whispers can be heard so easily through it.

Prove that sound passes through liquids. Plunge the head under water. Listen to the sound made by striking two stones together, or by ringing a little bell under the water. Tell the pupils how the ringing of bells, and other sounds made under the water, have been heard for long distances.

Observe that sounding bodies cause others to vibrate without touching them. Suspend a little strip of paper. Strike a blow with a tuning-fork. Hold the fork near the paper and watch the effect.

Mount a short distance apart two tuning-forks exactly in unison. Sound one of them and after a few seconds stop the vibrations. Notice the sound coming from the other.

Refer to experiments with air and recall how the air surrounds everything and is easily moved.

Strike the surface of water repeatedly and observe how the water moves in waves. Determine how the air moves in waves, with the trembling of the bell, the fork, and the strings.

Listen to the striking of a town-clock and notice how the sounds as they die away seem to come in waves, now loud, now soft. Explain this effect to the pupils.

Imagine waves of air going out from sounding bodies in all directions and striking against different objects. Tell the pupils how some of the vibrations enter the ear and produce the sensation called sound.

Tell the pupils the rapidity with which the air-waves must strike the ear—the lowest number per second and the highest—in order to cause sound.

Determine how low and high notes are produced.

INTERNAL STRUCTURE OF THE EAR.

Review the structure of the external ear. Observe the entrance into the canal, how it is guarded by hairs. Determine the use of the wax.

Obtain from the butcher the portion of bone containing the inner ear. Have it sawed open in such a manner as to show as much as possible of the internal structure of the ear.

Observe how the ear is imbedded in solid bone; the funnel-shaped passage leading from the outer to the middle ear; the partition or drum-head separating the two; the tube leading from the middle ear to the throat; the winding passages that form the inner ear.

Observe a diagram of the human ear. Find the parts corresponding to those observed in the specimen. Describe and sketch for the pupils the chain of bones in the middle ear. Observe in the diagram the partitions to which they are attached. Observe that if the first partition or drum-head shakes, the second one will also, and thus the vibrations will pass through the middle ear over the chain of bones to the inner ear. Will they stop here or go on? Tell the pupils of the liquid filling the inner ear. Will this carry the vibrations farther? Refer to the experiments proving that sound passes through liquids.

Recall the manner in which sensations reach the brain *i.e.*, by means of the nerves. Describe and illustrate on an enlarged scale the tiny nerves extending into the liquid in the inner ear, how they move or vibrate with the liquid, how they all collect into one main trunk or nerve that goes to the brain, and that the movement that passes through the liquid and makes the tiny nerves vibrate, finally, by means of this main trunk, reaches the brain.

Strike a bell and trace the sound from the bell until it is heard, *e.g.*, the motion or vibration of the particles of the bell; the vibration of the air in all directions; the entrance of the air-waves into the ear; the shaking or vibra-

tion of the drum-head and of the little chain of bones attached to it; the vibration of another drum-head and of the watery liquid in the winding-passages; the carrying of vibrations or message of sound to the brain by the nerves.

Refer to the many messages received; the rapidity with which they come and their different character; the distinctness and accuracy with which they are received.

Consider the pleasure afforded by the sense of hearing; the advantage of a quick ear; the necessity of caring for the ear and training it.

Read to the pupils the chapter on the "Music Room" from Marvels of Our Bodily Dwelling.

PRIMARY AND INTERMEDIATE.

CARE OF THE EAR.

Consider with the pupils the following topics: the necessity of carefully washing the ear; the effect of loud noises; the effect of cold air and of cold water; the effect of boxing or of pulling the ears; the effect of alcoholic drinks and tobacco on the sense of hearing.

GOOD-HEALTH CLUB LEAFLET.

Formulate rules relating to as many of the preceding topics as seem most essential to the teacher.

CHAPTER X.

THE EYE.

Helpful Books.—The same as those mentioned under preceding topics. Colton's Practical Zoology and Foster and Shore's Physiology, though of too advanced a character for the use of pupils, will give teachers valuable aid in the little work they wish to do in dissection. Any standard work on physics will give the necessary aid in teaching the physics of light. Dr. Lincoln's pamphlet, Essentials of School Hygiene, treats briefly and pointedly of the care of the eyesight.

SUGGESTIONS IN METHODS.

PRIMARY.

SIGHT.

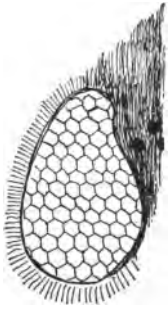
Observe the beautiful sights in nature and in art; describe objects and scenes as they appear to the eye. Name the organ by which one is able to describe in this manner.

Refer to blind people and how they obtain their knowledge through the other senses wholly.

Consider the advantage it is to one to possess the sense of sight.

Name different kinds of work that require strong, quick, well-trained eyes. Consider the means that must be used to have eyes in this condition (see suggestions on p. 106).

Consider the expression of the eyes in man and in the lower animals—how the eyes are the soul-windows of the boys and girls; how some eyes are honest, others kind,



and others gentle, etc., according as the soul looking out of the eyes is honest, kind, and gentle. Find animals that have large, bright, intelligent eyes; those that have small, dull, cruel, wild, or fierce eyes. Observe the eyes of different kinds of dogs, the bright sparkle of some, the quiet dignity of others.

An effort is being made now in all their school work to train pupils to see accurately and quickly. Not a subject can be named the correct teaching of which does not include the training of the eye. Reading, spelling, number, language, geography, drawing, writing, nature work, modelling, carving, etc., all give exercise to the eye, and the success with which these subjects are taught depends mainly upon the power of the pupils *to see.*

Special isolated exercises for training the eye are not necessary. Occasionally it is interesting to have tests of the eyes in regard to their general power to observe. For this purpose teachers may use the following: Uncover a collection of objects for a few seconds, then cover them, and have the pupils name all the objects they observed; expose an object to view for a few seconds, hide it, and call for a description; allow a few seconds for finding objects in the room having a certain color, then a certain form, etc.; show objects that have qualities in common, and compare and group them with reference to form, size, color, material, etc.; name the interesting objects seen on the way to school or at some other time; describe some one object seen at such a time; describe the sunset of last evening, etc.

EXTERNAL FEATURES OF THE EYE.

Notice the number of eyes in man and in the lower animals with which the pupils are most familiar. Find out whether there are animals that have no eyes or that have more than two eyes.

Observe the human eye—its position under the projecting, bony forehead; its apparent shape—illustrate its real shape by means of a small ball.

Observe and name the parts of the eye that are visible—eyebrows, eyelids, eyelashes, eyeball, white, iris, pupil, tears, and tear-ducts. Determine the use of each part. Observe how the pupil changes in size in different lights. Call the eyes the windows of the "House Beautiful" and the iris the curtain by means of which more or less light can be admitted. Observe what is done in an ordinary house when the day is dark or night coming on—how the shutters are thrown wide open and the shades lifted. Show the pupils the diaphragm in front of the lens of a camera, by means of which more or less light can be admitted. Compare the working of this diaphragm to the opening and closing of the pupil of the eye. Observe when the windows of the "House Beautiful" are wide open; when they are almost closed; whether the room into which they open is very dark or not.

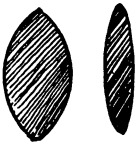
The chapter "The Windows," in Marvels of our Bodily Dwelling will aid the teacher in giving the pupils a figurative description of the eyes, if she cares to describe them in this manner.

Compare the eyes of man with those of the lower animals.

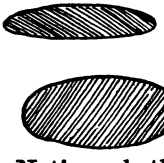
Observe whether the eyes of a horse, bird, fish, and other animals are placed in the fore part, on opposite sides, or on the top of the head. Observe the distance they are apart. Sketch for the pupils a flat fish that has both eyes on one side of its head.

Show the pupils the position of the eyes of a snail and a lobster on the tips of tentacles or stalks; of a scallop on the edge of its mantle; of a fly on the sides of its head.

Observe the shape and size of the eye. Find animals in which it looks round, as in the fish and the bird; those in which it appears oblong.



Observe the eye of the cat in the bright and in the dim light. Notice how the pupil changes in size and shape, how it differs from the pupil of the human eye.



Observe the peculiar shape of the pupil of the eye of a frog; of a horse, cow, and other animals. Sketch an outline of the pupils observed.

Notice whether the eyes of the animals observed have the same parts corresponding to those in the human eye. Find the third eyelid of the bird; observe how it moves across the eye. Observe whether other animals have this eyelid. Find out what animals have neither eyelids nor tears. Find the membrane at the bottom of the eye balls of the cat that causes its eyes to glow in the dark.

Examine the eyes of an insect with a glass. Tell the pupils of the three simple eyes on the top of the head and of the compound eyes, made up of thousands of simple eyes, on the sides of the head. Sketch on an enlarged scale the simple and compound eyes of an insect.

INTERMEDIATE.

EXPERIMENTS WITH LIGHT.

The following experiments are familiar to most teachers. They are suggested only in the briefest manner possible, in

order to show a line of work that is necessary before pupils can have a vivid, truthful idea of the mechanism of seeing. Several experiments should be given under each topic before inferences are made.

Direct Rays.—Determine that light travels in straight lines. Allow rays of light to enter a darkened room through an aperture. Cloud the air with dust. Trace the path which the light makes. Let the pupils make this observation in their homes and report it.

Cut holes in two pieces of paper. Hold them so that the sun shines through the two holes on a screen or piece of white paper. Move one of the two pieces. Observe the effect on the bright spot. Explain the result.

View a lighted taper through a narrow slit in a card. Move the card slightly. Explain why the light cannot be seen.

Show transparent, translucent and opaque substances. View objects through them. Observe how some allow rays of light to pass through them, others partially, and others not at all. Apply the proper term to each.

Reflected Rays.—Determine the direction of reflected rays of light. Allow rays of light to enter a darkened room and fall upon a polished surface. Cloud the air with dust and trace the path of the direct and the reflected rays. Observe that both travel in straight lines and that the reflected rays form the same angle with the reflecting surface that the direct rays do.

Allow sunlight to fall upon a little mirror held in the hands of a pupil. Observe the position of the image. Hold the mirror in different positions and determine before the rays are allowed to shine upon it where the image will be found.

Explain why images of objects are seen in polished surfaces. Determine where one must stand in order to see an image in the mirror.

Determine that objects are visible when rays of light fall upon them and are reflected by them to the eye.

Refracted Rays.—Determine the effect upon rays of light when allowed to pass through water. Observe the appearance of an oar or a stick in the water, of a spoon in a glass of water. Show that the rays of light are actually bent, on passing through water, by the following experiment: Allow rays of light to enter a darkened room and fall upon a glass vessel containing water; cloud the air with dust; trace the course of the rays of light before and after reaching the water.

Place an object in the bottom of a cup, held so that the object is invisible. Pour water into the cup. Explain why the object becomes visible. Give many other familiar illustrations and interpret them. Show how rays of light are bent by passing through a prism.

Color.—Receive the spectrum on a screen. Count the colors. Name the primary colors. Show how the seven colors are produced from these three, as orange from red and yellow, green from yellow and blue, etc.

Spin the color teetotum. (This may be obtained at almost any School Supply House.) Observe the effect produced by different combinations of colors.

Find prisms in nature, as in dew-drops, icicles, waterfalls, clouds, etc.

Determine what rays are reflected when objects look white; black; red; green; etc.

Look through pieces of different colored glass. Determine why the objects seen are of the same color as the glass.

Look through two pieces of different colors, as blue and yellow, at the same time, and explain the result.

Hold different colored papers or ribbons in different parts of the spectrum and account for the effect.

Lenses.—Determine the effect of lenses upon rays of light. Show different kinds of lenses; spectacles, watch

crystals, and magnifying glasses will furnish illustrations. Hold a lens in the sun's rays. Find the focus.

Fit the lens into a pasteboard screen. Allow rays from a candle-flame to pass through the lens. Receive the image of the flame on a movable screen. Hold the flame in different positions and observe the size of the image and its position, whether erect or inverted.

Hold a lens before the eye. Look at near and distant objects. Explain why it is necessary to move the lens in order to see the objects distinctly.

Show the pupils a camera. Explain to them the simple features of its working—the lens, the dark chamber, the sensitive plate, the light reflected from objects and passing through the lens, falling upon the plate and the appearance of the picture.

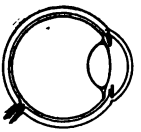
INTERNAL STRUCTURE OF THE EYE.

Review the external features of the eye, the shape, position, protection afforded the eye, position of the tear gland, ducts, etc.

A rubber ball may be used to give pupils an idea of the structure of the eye. Dent in one side of the ball; place a watch crystal in front of the dent to represent the cornea, back of the crystal a little colored circular curtain with a hole in the center to represent the iris and pupil, and back of this curtain in the dent a double convex lens.

The best object, however, to use in teaching the structure of the eye is the eye itself. Pupils feel no repulsion towards these objects when they are presented by thoughtful, interested teachers. Obtain from a butcher the eye of an ox and prepare it beforehand. That it may cut easily freeze the eye over night in salt and ice. Make a longitudinal section, cutting from the front towards the back that all the parts may be seen. It will now be possible to study the eye with interest and intelligence.

Show how the eye is placed in the socket and protected by the bones of the skull. Observe the fat with which it is surrounded and determine its use. Observe where some of the muscles were attached that move the eyeball. Observe the nearly spherical shape of the eyeball; the two chambers, front and back, into which it is divided; the lens separating the two parts; the two humors filling and giving firmness to the two chambers; the curtain or iris in front of the lens; the opening or pupil for the passage of rays of light; the transparent cornea fitting over the front of the eye; the tough outside coat of the eyeball and the dark brown one lining the chamber, the two uniting at the edge of the cornea; and the most important parts of all, the retina and the optic nerve. Impress upon the pupils' minds that, wonderful as the structure of the eye may be, it is not the eye that sees —that the eye, the optic nerve and the brain are necessary to sight, but that it is the mind that really sees through this organ.



Observe how the eye and the camera resemble each other —the dark chamber in each, both dark on the inside; an opening in each for the admission of light; a double convex lens in the camera that moves back and forth, and one in the eye that changes its shape, becoming more or less convex; the sensitive plate in the camera that receives the inverted image, and in the eye a plate far more sensitive, the retina, that receives and transmits to the brain every kind of picture that light can produce.

Trace rays of light from the object seen till they fall upon the retina.

Consider the use of the cornea and the humors in aiding the lens in bending the rays; the effect on the image of making the lens more convex and less convex; its action when objects are held close to the eye or far from the eye.

Determine why some people are near-sighted and some far-sighted.

Find the near point of vision and the remote point of vision of some of the pupils.

Explain what is meant by color-blindness.

PRIMARY AND INTERMEDIATE.

CARE OF THE EYES.

Having impressed upon the pupils' minds the value of the sense of sight—the enjoyment afforded by it and the advantages derived from it—and having made them somewhat familiar with the wonderful structure of the eye, they are ready to appreciate directions for keeping the eyes in a healthy condition.

Consider the following topics: Proper position when using the eyes; the kind and quantity of light and the direction from which it comes; the harm done the eyes from reading while working or traveling; the protection of the eyes when traveling; the need of frequently resting the eyes; methods of removing foreign substances from the eye; the effect of poor air, poor food, especially emphasizing the effect of tobacco upon the sight; the importance of having defects of the eyes treated by an oculist.

Teach as impressively as possible that the eye and all the organs of sense are to be touched only in the most delicate manner, and then only for the sake of cleanliness.

Dr. D. F. Lincoln's pamphlet, Essentials of School Hygiene, has brief, valuable suggestions relating to the care of the eyesight.

GOOD-HEALTH CLUB LEAFLET.

Embody the preceding topics in two or three rules.

NEEDS OF THE BODY.

CHAPTER XI.

AIR.

Helpful Books.—Orton's Comparative Zoology, Bissell's Manual of Hygiene, Reynold's Primer of Hygiene, any standard physiology and elementary work on physics and chemistry.

SUGGESTIONS IN METHODS.

Train pupils to perceive air and its condition by means of all the senses; to realize its presence in all places; to appreciate the joys it affords; to discover its uses; to understand gradually how it is used by man, the lower animals, and plants; to love pure air and to demand it at all times.

PRIMARY.

PERCEPTION OF AIR.

Wave the arms rapidly back and forth. Feel the air surging about the hands. Stand for a moment at the open door or window. Feel the air upon the face. Notice whether it feels hot or cold, dry or damp. Notice how it feels the first thing in the morning, and take a deep breath of it.

Look about the room and see if there is any motion of objects caused by the air. Observe objects outdoors in the

same way. Observe for a day the different movements caused by the air and report them.

Observe the sounds caused by the air—how it whistles, sings, roars, whispers, sighs and moans. Tell where and when these sounds have been heard. Listen for a day to the sounds caused by the air and report them.

Observe some of the odors that the air brings to us in different seasons—from the woods, the water, the fields when vegetation is starting and when it is dying, etc. Observe whether the air of different rooms has a sweet, clean odor. Object to anything that robs the air of its purity.

See health teachings on page 119.

USES OF AIR.

Picture to the pupils, with their aid, the great air-ocean surrounding the earth—its depth and color; the men, animals and plants at the bottom of it; how it heaves and rocks and rolls and smites; how it does work for us and brings us many benefits by its movements, propelling vessels, turning wind-mills, and bringing warmth to cold countries and coolness and moisture to hot ones.

Observe the chief use of air in keeping plants and animals alive.

Refer to the effect of fresh sunlighted air in rooms; how every good housekeeper admits it freely. Compare with this the house-cleaning process that is going on constantly in the "House Beautiful" as the fresh air passes in and out through its doorways. Impress upon the pupils' minds that, no matter how clean the outside of the House may be, no one is a neat, respectable housekeeper or "body keeper" who does not allow fresh, pure air to do its cleansing work inside.

BREATHING.

Study comparatively the organs, or doorways, by which air enters the bodies of animals.

Watch the rising and falling of the chest as air passes into and out of the lungs. Teach the terms "breathe in" and "breathe out."

Observe the two openings through which air may enter the body. Find out which is the smaller, more winding passage; which is the warmer; which is the better way for air to enter.

Observe the breathing movements of dogs, horses, cats, and other pets, and find out how air enters their bodies.

Provide a goldfish in a globe. Observe the movements of the mouth and gills of the fish. Prove that water is supplied with air by watching the little bubbles form and escape when water is heated. Tell the pupils water containing air passes into the mouth of the fish and flows out over the gills. Tell or show how other water-breathing animals get air, as the crab, clam, etc.

Show the pupils the breathing-holes along the sides of

the abdomen and thorax of a grasshopper or a beetle, and tell them that air enters the bodies of insects by means of them.

Tell how the earthworm, too, needs air; that it finds it under the ground among the particles of dirt, and takes the air into its body by means of its skin.

Observe that plants need air. Tell how the leaves and all parts of the plant are full of tiny holes, too small to be seen except with a powerful microscope, and that through these the air passes into the plant.

INTERMEDIATE.

EXPERIMENTS WITH AIR.

The work in physics related to this topic includes simple experiments with air from which the pupils determine some of its properties. *Telling* the pupils that air is a substance, though invisible, and exerts force, has no educative or practical value, while both these ends will be served if pupils are led to discover the truths for themselves.

A few experiments only are briefly suggested. Have the pupils observe the experiments and describe orally:

1. What was used, *i.e.*, the apparatus.
2. How the apparatus was used.
3. The result.
4. What was learned from the experiments after several illustrating the same truth have been performed.

Require written descriptions of the experiments, with simple outline sketches of the apparatus.

Physical Properties.

Matter.—Fit a funnel into a small-necked bottle. Try to pour water into the bottle.

Remove the funnel. Try to fill the bottle with water by plunging it mouth downward into a vessel of water. Determine why the water will not enter the bottle in either case. Refer to the definition of matter and classify air as matter or non-matter.

Extent of Air.—Require familiar examples proving that air extends upward and downward and completely surrounds the earth. Tell the pupils that its height above

the earth is about fifty miles. Recall the diameter of the earth in round numbers. Compare the height of the air with the diameter of the earth. Draw a circle two feet in diameter. Represent by means of another circle a layer of air around the first one sixth of an inch thick. Teach the term "atmosphere" (*atmos sphere*).

Pressure in all Directions.—Fasten rather loosely over each end of a lamp-chimney a piece of rubber dam, that can be obtained of any dentist. Hold the chimney in different positions. Pull out the rubber on one end. Observe the effect on the opposite end and determine the force that produced it.

Place some colored water in a glass. Insert one end of a glass tube into it, and carefully suck the air from the tube. Determine why the water rises. Watch the changes in the barometer from day to day and explain them.

Effect of Cold and Heat.—Suck a drop of colored water into the middle of a glass tube. Close one end with the finger. Apply ice to the tube between the drop of water and the closed end. Then dry the tube and apply a lighted match. Watch the drop of water and account for its movement in each case.

Account for the snapping of coal and wood in the fire; the bursting of toy balloons when they fall on the stove. Give other familiar examples illustrating the effect of heat.

By means of a thermometer test the temperature of the air in the upper and the lower parts of a room. Determine why the air in the upper part is the warmer.

Open a door leading from a warm room into a cold one. Suspend a little strip of tissue-paper at the top and the bottom of the opening and observe which way currents of air are moving. Determine why they move in this manner.

Determine why stoves, registers, and radiators should be near the floor.

Composition.

A line of work will be only briefly suggested under this head. "First Steps in Chemistry," published by D. C. Heath, will furnish the teacher valuable help.

Oxygen.—Put a teaspoonful of chlorate of potash and one of manganese dioxide into a test-tube. Connect with a delivery-tube and gradually heat the test-tube over a flame. Invert three bottles previously filled with water in a water-bath. Collect in the bottles the gas that is being given off from the test-tube.

Determine whether the gas has color, odor, or taste.

Thrust a glowing stick into one of the bottles. Repeat the act until the stick is no longer relighted.

Heat a watch-spring red hot, dip it into sulphur, and thrust it into a second bottle.

Place a piece of phosphorus in a deflagrating wire. Set fire to it by touching it with a hot end of a wire, and plunge it into a third bottle.

Compare the burning of these substances in the gas with their burning in air.

Sum up the properties of this gas and name it oxygen.

Tell the pupils briefly of its discovery in 1774; that it is found in earth, air, and water, in animal and vegetable structures, as well as in the rocks.

Consider the uses of oxygen—to support combustion; to support life—plants, animals, and men all breathing oxygen.

Nitrogen.—Place a metal float in a shallow dish of water. Lay a small piece of phosphorus on the float and touch it with a red-hot wire. Immediately invert over it a wide-mouthed bottle or bell jar, leaving it until the smoke has entirely disappeared. The phosphorus unites with the oxygen in the air, forming a solid soluble in water, thus leaving almost pure nitrogen in the bottle.

Observe the color, odor, and taste of the gas formed.

Observe the height to which the water has risen in the bottle. From this estimate the proportion of oxygen in the air; of nitrogen.

Lower a lighted splinter into the bottle. Observe the effect.

Sum up the properties of this gas and name it nitrogen.

Consider the important use of nitrogen—in the atmosphere to dilute the oxygen; in meat, eggs, milk, and grains to supply a necessary food to man.

Carbonic-acid Gas.—Burn a piece of wood in a glass jar, the top of which is loosely covered. When the wood will no longer burn, remove it.

Light a fresh piece of wood and lower it into the jar. Observe that it will not burn. Determine whether there is oxygen in the jar. If there is none find out what has become of it.

Observe the new gas formed, its color, odor, taste.

Pour limewater into the jar and observe the effect.

Sum up all that has been observed in regard to this gas and name it carbonic-acid gas or carbon dioxide.

Tell the pupils where the carbon came from; the oxygen.

Breathe through a glass tube into some limewater. Observe the effect upon the limewater. Make an inference in regard to the presence of carbonic-acid gas in the air exhaled.

Find out what becomes of the carbonic-acid gas given off into the air by our breathing and from our fires and lights. Tell the pupils that plants breathe with all their parts, taking in oxygen and throwing off carbonic-acid gas the same as man; that when the sun shines plants, by means of their green parts, take from carbonic-acid gas carbon, which is used as food.

Consider whether carbonic-acid gas is poisonous or not; why it is bad to have too much of it in the air; what its presence indicates in a room where there are many people.

Watery Vapor.—(See Vaporous Form of Water, Chap. on Water.)

Combustion.

Necessary Conditions.—Place a lamp-chimney over a lighted candle. Cover the top of the chimney. Uncover the top and do not allow air to enter at the bottom. Allow air to enter at both top and bottom. Make an inference in regard to the conditions necessary for combustion—the need of air, the inlet and the outlet.

Refer to the experiments in oxygen, nitrogen, and carbonic-acid gas, and name the element necessary for combustion.

Study the draughts of stoves, the necessity of air, how its inlet and outlet are provided for.

Products.—Hold a lighted splinter or taper over burning charcoal, kerosene, or alcohol. Explain why it is extinguished.

Collect some of the gas formed by combustion. Shake it in limewater and observe the effect.

Place a cold chimney on a lighted kerosene lamp. Hold a tumbler a short distance above an alcohol flame. Observe the watery vapor.

From the preceding experiments determine the products of combustion.

RESPIRATION.

In the primary grades the pupils learned how air entered the body of man and of the lower animals. The next step in anatomy is to gain a more definite idea of the organs receiving the air. In the Intermediate grades a general knowledge may be gained of the position, number, size, shape, structure, and use of the lungs. Since the heart and its use are so intimately connected with the lungs, the general features of the circulatory system may be considered in connection with respiration.

The Organs.

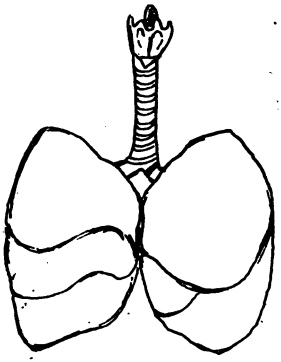
Watch the chest in breathing. Place the hands upon it and upon the abdomen and observe the rise and fall of their walls in breathing. Study the structure of the walls of the chest; the bones that form the framework and the movement of which they are capable; the means by which the walls are lifted.

Observe the relation of the rise of the walls to the inhaling of the air; the fall of the walls to its expulsion.

Tap the chests of several children. Notice the sounds produced.

Outline on the chests of several pupils the position of the organs receiving the air.

Show the pupils a picture of the human lungs on a good chart.



The inflated lungs from any animal are always beautiful and will appeal to the pupils as such if shown by an appreciative teacher. Get from a butcher the heart and lungs entire of a calf, pig, or sheep.

Observe the number, shape, size, and attachment of the lungs to the windpipe; their pinkish color; smooth surface; lightness (float them in water); spongy structure.

Compare the specimen with the human lungs shown on the chart.

Observe the windpipe. Notice the incomplete rings of cartilage and determine why they are incomplete. Observe the two branches from the windpipe leading to the lungs. Trace one of the branches as it divides and subdivides. Tell the pupils about the tiny air-passages and air-sacs that compose the lungs and thus account for

their lightness and spongy structure. Trace one of the large blood-vessels leading to the lungs. Illustrate how it divides and subdivides, forming the finest network all over the lungs, as shown by their pinkish color.

Locate the position of the windpipe in the chests of the pupils. Have them feel the hard part in the throat. Show them the shape of this little box, or larynx, on the chart and explain its use. Make an outline drawing of the specimen and write a brief description of what has been observed.

The Act of Breathing.

Refer to experiments with air. Recall how it presses in all directions, moving easily in the direction from which there is least resistance.

Illustrate breathing by means of the following piece of apparatus: Represent the chest cavity and diaphragm by means of a large-sized lamp-chimney, over the bottom of which is fastened a piece of thin rubber dam. Fit a rubber stopper into the top of the chimney and through this pass a glass tube, upon the lower end of which is tied a toy rubber balloon. The tube and the balloon represent the windpipe and lungs. The balloon will more truly represent the lungs if it is partially inflated before the cork is inserted. For convenience in handling, tie a string firmly to the centre of the piece of rubber dam. By pulling the rubber bottom down and then releasing it the air will pass into and out of the balloon through the tube, causing the balloon to expand and contract as the lungs do in breathing. Find out what causes the change in the size of the balloon.

Determine by careful questioning that the pressure on the balloon is lessened when the rubber bottom is pulled

down, and the air therefore moves from the opposite direction through the tube, inflating the balloon; that the pressure on the balloon is increased when the bottom is released and the air is then driven out of the balloon.

Find the correspondence between the action of this piece of apparatus and of the chest and lungs in breathing.

Guard against the common error in thinking that the walls of the chest rise because the air is sucked into the lungs expanding them, when the reverse is true—the lifting of the walls of the chest causing the air to rush into the lungs.

The Function of Breathing.

Consider the object of breathing, viz., to purify the blood.

Describe the waste that takes place as one works or plays, and the need there is of new material.

Consider the source from which the new material is supplied; how the waste is removed.

Consider the part removed by the lungs and the element received by them.

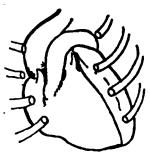
Consider how the work of nourishing the body and removing its waste is accomplished by means of the heart and blood-vessels.

CIRCULATION.

The Organs.

Place the hand a little below the centre of the chest and to the left. Observe the movement. Find out the cause.

Show a picture of the human heart on the chart.



Observe its position with reference to the lungs.

Observe its shape and size.

Show the pupils the heart of a sheep. Observe its shape; size; color; surface; the strong, thick, muscular walls. Name and

point to the base by which it is attached; the apex; right side and left side; front and back.

Show by means of specimens, pictures, and drawings the shape and position of the heart and lungs in quadrupeds.

Locate in a general way the lungs and heart of birds. Tell the pupils how the air passes from the lungs of birds to other parts of their bodies. Ask them to find the lungs, or "lights," and the heart of a fowl the next time one is dressed at their homes.

Find the heart and the organs that correspond to lungs in a fish. Find out what becomes of the bubbles of air swallowed by a fish; whether any part of the air is received into the body; the position of the air-bladder and the source of the gases with which it is supplied.

Do not enter into details of structure, such as auricles, ventricles, valves of the heart, etc. Impress upon the pupils' minds the general work of the heart.

Observe the veins in the hands, wrist, and face. Determine which way the blood is flowing in them, why the blood looks dark.

Place the fingers gently upon the thumb side of the wrist. Observe the movement. The beating of the pulse may also be shown in the following manner: Place a bit of looking-glass on the wrist over the pulse. Let the sunlight fall upon it in such a way that it will be reflected upon the wall of the room. The movement of the spot of light will show the sudden filling of the artery and its slower contraction.

Observe the pinkish hue of the skin due to the presence of the blood in the capillaries, and from this judge of their number and size.

The Action of the Heart.

Illustrate the action of the heart and the pulse in the arteries by means of a common syringe-bulb to which a

short piece of rubber tubing is attached for suction and a piece several feet long for the delivery of water. Fasten in the open end of the long piece a glass tube drawn out to a fine point. Connect the short piece of tubing with a vessel of water. Compress the bulb. Observe how the water flows in pulses through the rubber tubing; how it flows from the glass point in a steady stream. Explain the movement. Compare this movement to the movement of the blood through the arteries and tiny capillaries.

Give the pupils a general idea of the circulation of the blood by means of the chart. Show them the arteries carrying the pure blood laden with oxygen and nourishment to every part of the body. Show them the veins in which the blood, laden with carbonic-acid gas and other impurities, is slowly returned to the heart after it has done its work in building up the body and furnishing power and heat. Show them the arteries by which the blood is sent to the lungs for cleansing and the veins by which it is returned. Omit unfamiliar terms and read to the pupils the chapters "The Purifying Apparatus" and "The Force Pump" from Marvels of Our Bodily Dwelling.

The Function of the Heart and the Blood.

Consider the use of the heart in all animals, *viz.*, to keep the blood moving.

Consider the use of the blood in all animals, *viz.*, to bring nourishment and to carry off waste. Find out about the different color and temperature of the blood in different animals.

Consider the importance of having a sound heart and pure blood.

Consider the relation of the following to a good circulation: nourishing food; pure air; exercise; loose clothing; morning bath; abstinence from tea, coffee, alcoholic drinks, and tobacco.

PRIMARY AND INTERMEDIATE.

PURE AIR.

Make a list of the rooms, buildings, and vehicles in which it is necessary to have pure air.

Consider the causes of impure air—people; animals; plants at night-time; fires; lights; want of sunshine and cleanliness.

Determine where the air is the purer—outdoors or indoors; in the city or in the country.

Consider the best means for keeping the air pure—the necessity of ventilation; sunlight; the free use of water.

Consider simple means of ventilating if ventilators are not provided—the fireplace; lowering the window from the top; raising the window from the bottom and fitting a felt-covered board under the lower sash; the double panes of glass, the outer one having an open space at the bottom and the inner one having an open space at the top.

Refer to experiments with air and recall whether warm or cold air will be near the floor. Determine where it is best to have warm air enter and where cold.

Consider the necessity of throwing open the windows and doors every morning and thoroughly airing every living-room in the house.

Consider the necessity of airing clothing and bedding.

Train the pupils so they will be sensitive to the condition of the air in their sleeping-rooms. Have them notice whether it is sweet and pure on retiring and on rising. Consider the proper temperature for rooms (not over 70° F.).

Induce the children to buy thermometers for their homes and to look at them often.

Test the air in the schoolroom. (Use Fitz's Air-tester or a lime-water test described in Bissell's Manual of Hygiene, p. 46.)

BREATHING.

Consider the effect of tight and of loose clothing upon breathing.

Consider how a clean skin aids the lungs in their work.

Train the children to maintain an erect position at all times and to keep the mouth closed. This habit will enable them to breathe properly.

Pupils enjoy exercises like the following and are refreshed by them. See that the room is well supplied with fresh air when the exercises are taken.

Suspend a tissue paper bird by a string 18 inches long. Have the pupils march under it and with one exhalation blow the bird as high as the point of support. Suspend a bird made of silver paper and repeat the action, then one made of two thicknesses of gold paper. The last will require the strongest effort from the lungs.

Imitate the steam-engine—inhale and exhale, making at the same time the sound *sh*.

Imitate the wind blowing mournfully down the chimney or among the pines—inhale and exhale, making the sound *oo;* etc.

Inhale slowly and exhale very carefully, as if blowing imaginary soap-bubbles.

Move quietly about the room and keep bits of down or paper floating in the air by means of the breath.

Inflate toy balloons (with practice this can be done with one exhalation), tie them, toss them into the air, and by gentle taps and gentle movements about the room keep the balloons from touching the floor for a stated length of time.

With older children practise exercises like the following:

1. Assume a good standing position; extend arms sideward; first count—raise the arms, quickly rising at the same time on the heels, inhale; second count—let the arms and heels sink slowly to position, exhale; repeat.

2. Assume a good standing position, extend the arms

forward ; first count—raise the arms quickly, rise on the heels, inhale ; second count—slowly lower the arms sideward, palms of hands upward, let the heels sink to position, exhale ; third count—turn the palms of hands downward ; fourth count—bring the arms to the first position ; repeat.

Consider the value of breathing exercises—their relation to a well-developed chest and lungs.

TOBACCO AND ALCOHOLIC DRINKS.

If the teacher loves pure air and demands it at all times

she will gradually inspire a like feeling in her pupils. The boy whose senses have been trained to perceive air, who knows its value, loves it, and demands it will object to breathing air laden with tobacco-smoke and will never be guilty of taking the smoke directly into his lungs in the act of smoking. With this positive teaching for a basis, with a slow but true implanting in the mind of ideals of health, purity, and cleanliness, words of warning may be given in regard to the effect of tobacco and alcoholic drinks and they will be very effective.

As young pupils know only of the general structure of the internal organs, only general effects can be given.

Consider the effect of tobacco upon the organs of breathing, often causing a dry, inflamed throat, inflamed windpipe, husky voice, delicate lungs that gradually become less and less able to do their important work.

Consider the effect of alcoholic drinks upon the heart and the blood-vessels—at first spurring the heart to quicker action, enlarging the little blood-vessels, flushing the face, and quickening the action of the lungs, but not permanently increasing strength or making the body warmer. (See Dr. Richardson's Temperance Lesson Book.)

Refer to the practice of athletes, who, wishing heart and lungs to be as sound as possible, abstain entirely from the use of tobacco and alcoholic drinks.

GOOD-HEALTH CLUB.

Formulate statements or rules relating to the following: simple means of ventilating; thorough airing of rooms, clothing, and bedding; the importance of holding the chest erect and breathing through the nose; the necessity of a clean skin; the non-use of tobacco and alcoholic drinks; and such other topics as the teacher may think advisable.

CHAPTER XII.

FOOD.

Helpful Books.—Richard's Food Materials and Their Adulterations; Abels' The Five Food Principles; Vaughan's Healthy Homes and Foods for the Working Classes; all the bulletins issued by the U. S. Department of Agriculture, on the sources, treatment, and cooking of food, costing only a stamp for the order; pamphlets on table-manners, Don't and Dewey's Teaching Manners in the School-Room; Needham's or Orton's Zoology; any standard physiology; Wood-Allen's Marvels of Our Bodily Dwelling; Stevenson's Boys and Girls in Biology; Lovejoy's Nature in Verse; Poulsson's Finger-Plays.

SUGGESTIONS IN METHODS.

Lead the pupils to see the following relations:

1. *The relation of different articles of food to plant and animal life.*

Find the origin of different articles of food; then trace forward from the origin, step by step, through all the processes by which the food is made ready for the use of man.

As in the kindergarten the children are led to trace the origin of their gifts back to nature, and say, "I thank you," so in the higher grades a most important moral lesson in true appreciation and gratitude accompanies the teaching of the processes by which food is made ready for the use of man.

2. *The relation of man to plant life.*

Observe the dependence of man upon animal and plant life; the ultimate dependence of all animal life upon plant

life, thus leading the pupils to realize that plants are vital forces in this world.

3. *The resemblance between man and the lower animals.* Lead the pupils to see the resemblance between man and lower forms of animal life—(*a*) in their common need of food; (*b*) in the character of the food used by them, being of animal or of vegetable origin; (*c*) in the organs by which the food is prepared to nourish the body.

4. *The relation of good health to good food.* Consider the important function of food in the body, in building and repairing and supplying with power; the kinds of food that are necessary; the advantage of selecting the most nourishing food and of preparing it properly.

PRIMARY.

KINDS OF FOOD.

Have the pupils tell orally or write a list of the articles of food which they eat daily.

Test the knowledge of the pupils in regard to the origin of food by having them write statements telling the origin of each article mentioned. This exercise will probably convince the teacher of the need of instruction along the following lines.

Grains.

Suggestions are given for the study of wheat only. The same general outline may be followed in studying other grains.

Wheat.—Trace bread to its origin. Name the kind of flour of which it is made. Bring samples of the following: Whole wheat, bran, rolled wheat, farina, Graham flour, and fine white flour. Name the plant from which these specimens are produced. Show the pupils stalks of wheat that were gathered, perhaps, in the summer vacation and preserved for study in the winter.

Teach about the planting and the growth of wheat. Picture the fields, level, rolling, or hilly, enclosed by fences, or reaching as far as the eye can see. Describe the plowing and the preparation of the soil. Show a copy of Millet's picture of The Sower.

Illustrate the movement in sowing grain by an exercise, as follows: Count three: one—advance left foot and take a handful of grain from an imaginary bag suspended from the neck in front of the waist; two—swing the right arm to the right as far as it will reach, turning on the right foot; three—bring the right arm around with a sweeping movement, as if scattering the grain, at the same time advancing the right foot; repeat, moving around the room.

Learn whether wheat is raised in the locality of the school or not; when it is sown; when it is harvested; the difference between spring and winter wheat; the places and climate best adapted to raising wheat. Learn how to distinguish wheat from other grains when it first comes up. Question farmers in regard to this, and learn whether wheat is darker or lighter in color than other grains.

Examine the leaf, head, and stalk of wheat. Describe and draw them.

Describe the appearance of a field of waving wheat.

Describe the manner of harvesting wheat—with a sickle, a cradle, and a harvesting-machine.

Illustrate cradling by the following exercise: Count two: one—advance the right foot, raise both arms upward to the right, as if lifting a scythe or cradle; two—bring both arms downward, to the left, with a sweeping movement, as if cutting the wheat. Repeat the movement, the pupils advancing down the aisles or around the room.

Describe the binding. Draw the sheaves of wheat. Picture the loading and unloading of the wagon.

The preceding processes are described with appropriate action in the song, "How the Corn Grows." (Poulsson's Finger-Plays.)

Refer briefly to improved methods of harvesting with machinery; the saving therefrom in time and labor.

Describe the processes by which the grain may be separated from the head—by treading, the flail, and the threshing-machine.

Illustrate the movement with a flail by an exercise. Count two: one—grasp an imaginary flail, raise both arms upward to the right; two—bring the arms downward, as if threshing.

Learn the condition of the grain after threshing. Describe the fanning process.

Name the place where the grain is stored.

In imagination carry the wheat to the mill, that is run perhaps by wind, by water, or by steam.

Imitate the windmill by an exercise. Extend the arms horizontally at the sides; without moving the arms twist the trunk from right to left and from left to right, counting two.

Watch in imagination the miller as he puts the wheat into the hopper, and see the great stones slowly crush it. Describe the movement by action. Then, as it is sifted, learn how the different kinds of flour are made.

Sing the song "The Mill." (Poulsson's Finger-Plays.)

Examine grains of wheat. Find and name the three parts—husk, hull, and pulp. Determine which part is thrown away and by what process.

Examine the specimens of flour. Observe how they differ in color and in fineness. Crush some kernels of wheat. Observe the color of the flour. Compare it with the Graham flour, with the fine white flour.

Scrape off the hull from kernels of wheat. Observe its color and that of the pulp inside. Determine which part alone is used in making fine white flour.

Impress upon the pupils' minds that the best and cheapest flour is made from whole wheat; i. e., when the hull and the pulp of the kernel are both present.

Gather from the pupils all they know about bread-making—the ingredients, putting them together, moulding, etc. Then illustrate bread-making in a make-believe manner by singing the song, "Making Bread." (Poulsson's Finger Plays.")

Review the entire work in the following manner: Hold grains of wheat in one hand and a piece of bread in the other; call for statements to be given orally, quickly and in order, telling the processes by which the wheat is made ready for bread.

After a topic has been completed, require the pupils to tell the story briefly in writing. Preserve one of the exercises.

After the specimens have been studied, place them in small bottles, and mount them by means of narrow ribbon on card-board. Preserve the sets with the best written exercise in a cabinet.

Study other grains, as, rye, oats, barley, buckwheat, rice, and corn, in a similar manner, teaching the use of these articles for food and the forms in which they appear usually on the table. Preserve the specimens of the

different grains and written exercises concerning them, as indicated under the preceding topic.

Commit to memory the poem "Corn." (Nature in Verse.)

Nuts.

Name and describe different kinds of nuts. Learn whether they are used generally as articles of food. Find out what kinds grow at home; that grow abroad; their value in some countries to men and animals. Distinguish the trees on which the home nuts grow by their shape, size, bark, leaf, and blossom. Observe how the nuts grow; their protection; time of ripening; method of gathering; use.

Commit to memory "Gossip of the Nuts" and "Little Nut People." (Nature in Verse.)

Fleshy and Stone Fruits.

Study the fleshy and stone fruits used for food, as, the apple, berry, cherry, etc. Teach that the term "fruit" is applied to the part of the plant holding the seeds. Include then, under the head of fleshy fruits, the tomato, cucumber, pumpkin, etc.

Observe or recall whether the fruit grows on a tree, a shrub, or a vine; the leaf and blossom; whether the fruit grows singly or in clusters.

Distinguish the different fruit trees by their shape and bark in the winter; by their leaves and blossoms in the spring.

Observe, or inquire, when the different fruits ripen; how they are gathered; how disposed of.

Consider in a simple manner the effect of soil and climate on the growth of fruits; why certain fruits or vegetables do better in a certain part of a farm, locality, or country, than in others.

Consider in what condition fruit should be eaten—perfectly ripe, but not over-ripe; the kinds that are better raw; those that are better cooked, and why.

Talk about the many ways, and the most healthful ones, in which the different kinds of fruit can be used, *e. g.*, the apple — raw, baked, stewed, jelly, marmalade, dumplings, pie, and cake—the most healthful of all the preceding ways being raw or baked.

Make the fruits tempting—hanging on the trees; stored away in the cellars; decorating the table in a dish; in whatever way they may be used.

Watch for stanzas or poems that describe the fruits, like "Winter Apples," found in Nature and Verse, and commit them to memory.

The aim in the teacher's mind should be to lead pupils to see such facts relating to growth and production that nature's "gifts" may be appreciated; to fill the minds of the pupils with thoughts of the right use of the most healthful articles of food, creating unconsciously a desire for such food, and thus aiding in forming a most important habit.

In teaching the use of fruits and grains, reference can be made to their abuse in crushing them into alcoholic drinks. Teach the harmlessness of the juice in the fruit, or when it is first pressed out; the change that takes place after it

has been exposed to the air and moderate warmth; that drinks that contain alcohol are not the drinks for one to use who desires the best health and strength; that they are not safe drinks, even in moderation, because of the habit that may be formed that leads to drunkenness.

(See Chapter, Temperance Teachings.)

Other Foods of Vegetable Origin.

Continue the lessons on the origin of food, teaching about plants whose leaves or stalks are used for food, as, lettuce, spinach, cabbage, asparagus, etc.; how, when and where they are raised. Show pictures of the plants, name them, sketch the leaf, describe the ways in which they are used for food, and tell the best ways.

Teach about plants whose roots or underground stems are used for food, as the beet, potato, etc.

Teach that honey, sugar, molasses, and other sweets are of vegetable origin, also the oils made from the olive, peanut, and cotton-seed.

While the use of tea, coffee, and even cocoa by young children is to be discouraged, and they are gradually to be led to discard, as a rule, all drinks except milk and water, still, owing to the general prevalence of the custom of drinking tea and coffee, it seems practically necessary to teach how to make a good cup of tea, coffee, and cocoa. (See Mrs. Abel's Essay, p. 133.)

Animal Food.

Find out the kinds of food that are of animal origin.

Name the animals from which come beef, mutton, pork. Teach the pupils how to broil meat in the simplest manner possible. Request the pupils to pratice at home and report results.

Name some of the kinds of fish and fowl that are used for food. Give definite directions for one good way of cooking these articles. Study other articles of food that

are of animal origin, as eggs—the different kinds, the best kinds, several ways of cooking them; milk—different kinds, its value as food; cheese and butter—something of the processes by which they are made. "Making Butter," a song in Poulsson's "Finger Plays," very prettily describes the process of making butter.

WHY THE BODY NEEDS FOOD.

Discuss this topic with the pupils in a simple manner, and determine that the body needs food in order to grow, to keep it warm and strong, and thus able to do its work; that plants and lower animals need food in order to grow and be strong and do their work.

KIND OF FOOD NEEDED.

Determine with the pupils that in order to be as healthy and as strong as possible, and do the best work of which one is capable, the very best food should be eaten; that the best food is not the finest, richest, and most expensive, but oftentimes the plainest and cheapest. (See Atwater's pamphlet, Foods.)

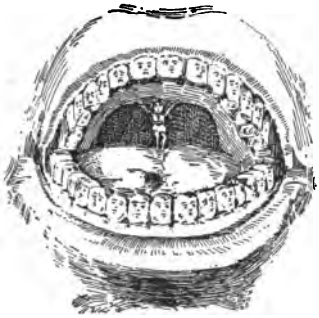
From the articles of food studied select, with the pupils' aid, those that are suitable for breakfast, dinner, and supper.

HOW THE BODY USES THE FOOD.

The process of digestion is best described to little children in a semi-figurative manner. Valuable suggestions along this line are given in Marvels of Our Bodily Dwelling. Omitting many technical terms, abridging and changing the description given by Dr. Wood-Allen, the story for primary children would run, briefly, something like the following:

A pair of pink folding-doors opens into the reception-room. This is circular in shape, has an arched ceiling, and is beautifully hung in pink. As the guests brought by

the waiters, called Hands, enter, they are received by thirty-two attendants dressed in white uniforms. Sometimes all these servants are not present, and sometimes their uniforms are not perfectly white, but are soiled and patched, the patching being done with gold. It is the duty of these servants to make the visitors *fine* enough to be presented to the cooks of this wonderful House. In little new Houses these servants cannot be seen, for they are asleep in pink cradles. They wake up finally, one at a time, until twenty of them have poked their little crowned heads out of their cradles. They are soon ready for work. They need much bathing and scrubbing to keep them in good health.



A little guard, dressed in red, is in the centre of the floor of the hall, which he never leaves. It is considered bad manners for him even to put his head outside the door. His name is Tongue, and it is his business to pass an opinion on all the guests received. Sometimes he uses very poor judgment, and admits all who happen to please him, whether they are for the good of the House or not.

Opening into the reception-room are six little closets, three on each side, where six other servants stand ready to help the guests along. Some of these guests have hard natures and very "starched-up" manners. It is the duty of the six servants, called Saliva, to meet these guests in the reception-room and keep them there until they have become softer and sweeter mannered, and then go with them to the kitchen.

(After hearing the description of the mouth told in this

manner, the children will be delighted to solve the story-puzzle by describing the reception-room in literal language. The lips, the teeth, the tongue, its place in the mouth, will be observed with a new interest. The "six little closets" where the saliva is kept will puzzle them, but they will be interested to have the teacher show where they are located, and, by means of a chart, how they look.

Telling the story a second time in an elliptical manner, i. e., pausing after every term or expression used figuratively and allowing the pupils to supply the literal language, is an interesting method.)

The hall leading from the reception-room to the kitchen stairs is very peculiar. It is separated from the reception-room by two pink pillars, between which hangs a pink curtain that can be drawn up and back. The hall has no floor, but instead there are the openings to two passages leading downward, one closed by a trap-door, the other being always open. There are seven passages in all opening from this hall, but the one in which we are particularly interested now is that leading to the kitchen.

The kitchen stairway is about nine inches long and nearly an inch wide, not quite straight, and its walls are thick but movable. As soon as the guests enter, the walls close behind them, and they are pushed along downward, whether they will or no. On reaching the bottom of the stairs a circular door opens and down they jump into the kitchen.

(Aid the pupils in retelling literally, the story of the stairway as in the case of the reception-room. Have them locate on their bodies the throat, gullet, and stomach. If, in this connection, they were shown the pictures of these pretty rooms and halls as represented by the organs on a chart, these organs would not be repulsive to the children.)

This is one of the most important rooms in the house. When full it is about one foot long and four inches wide.

Its walls are thick and strong, but they can move in different directions. Hidden in the sides and floor and ceiling

are thousands of little closets in which the cooks stay until they are needed. We will call these cooks by one name, Gastric Juice, the same as all the boys in a store are called Cash. As soon as the guests enter the kitchen the little cooks rush out from their closets, the walls of the kitchen begin to move in three different directions, and the guests receive such a shaking, soaking, and mixing that finally one cannot be told from another.

(Find where this kitchen is located. Sketch an outline showing its general shape. Associate hygiene with the topic in the following manner.)

The little cooks are very kind and industrious, never quarreling among themselves or "going on strikes" if they are well treated. But if they are abused they become very cross; a little rumble comes up from the kitchen, and then sometimes such a tumult follows that all the guests are turned out at the front door. The cooks object to great crowds of guests coming in at the same time, or to their being washed rapidly down the stairs by large quantities of ice-water. They object very strongly to receiving certain guests

at all. They love such ones as Eggs, Fresh Meats, Vegetables, Milk, and Fruits. They growl over Pie and Pickles and Candy and Tea and Coffee, and if that intruder Tobacco is taken into the reception-room, then a strike is de-

clared, the fires go out, all the work stops, and for a time it looks as if the House Beautiful had fallen in ruins.

(Enlarge upon all the preceding descriptions. Tell the stories in as picturesque a manner as possible, being aided by the pupils, adapting the language and style to their comprehension. If it is thought advisable, continue the stories, describing the store-room where the food is stored and further prepared by other servants, and the long dining-room from which it is finally sent to every part of the house.)

INTERMEDIATE.

KINDS OF FOOD.

Review the work of the preceding years on Food. Teach additional facts. Classify foods as animal and vegetable, discovering a new class, mineral food.

Vegetable Food.

Classify vegetable food as fruits—fleshy, stone and dry; leaves of plants; roots, tubers and stalks; oils; sweets.

Review description, varieties, manner and conditions of growth, use, best methods of using these articles of food. Teach, as in the lower grades, appropriate poems, or stanzas from them, as Whittier's "The Huskers," "The Corn Song," "The Pumpkin;" Riley's "When the Frost is on the Punkin," etc. Teach not only the theory of cooking, but require practice-work in the same, from both boys and girls.

Animal Food.

Classify animal food, giving a broader and more practical knowledge of each kind. Consider the following topics.

1. Beef—the names of the different cuts, as neck, shoulder, chuck rib, sirloin, round, rump, flank, etc., the most nutritious cut—not always the tenderest, finest flavored or highest priced; the structure of the meat—connective tissue, fat and fibres, or little bags, containing the food-substance, flavors, water, etc.; the wisdom of buying fat beef; the appearance of good beef—bright red, streaked with fat, not too moist, no odor; the necessity of cooking meat; two or three of the best methods of cooking beef. (See Mrs. Abel's Essay, pp. 41-43.)

2. Lamb and pork—treat in the preceding manner.

3. Fish—salted, smoked, and fresh; different kinds in different places and at different seasons; salt water and fresh water fish; the nutritive value of dried codfish; one or two good ways of cooking fish.

4. Fowl—names of domestic fowl and some of the most familiar wild birds that are used for food; best ways of cooking fowl; names of different parts of the fowl when served.

5. Eggs—different kind used for food; value as food; different ways of cooking eggs.

6. Cheese—different kinds; value as food; use in foreign countries.

7. Milk—value as food; care necessary to keep it sweet; effect of heat and cold; object of boiling milk.

Require pupils not only to observe, hear, and repeat how these articles of food shall be cooked, but to write a description of the different methods of cooking as practised by themselves at home.

Mineral Food.

Burn animal and vegetable food until only ashes remain. Name the part remaining "mineral matter."

Name the hard parts of the body that require mineral matter, as the bones and the teeth. Tell the pupils that mineral matter is found in the composition of all parts of the body and must be supplied to them by the food.

Determine the source from which vegetable food obtains the mineral matter in its composition; animal food. Discover the most common and necessary food that comes under this class, viz., water. Teach that with the exception of water and salt, mineral food cannot be taken into the system by any animal only as it is obtained from vegetable or animal food. Tell the pupils that the earthworm appears to be an exception. Find out whether it is or not.

Unwholesome and Injurious Food.

Briefly call the attention of the pupils to articles of food that are more or less harmful, which are freely used by the careless, the ignorant, and by those who strive to practice a poor economy. Include under this head the following:

1. *Indigestible and unnutritious food,* such as pie, cake, rich puddings, pickles, candy, etc.

2. *Unripe and over-ripe, or decayed, fruit,* such as is greedily eaten by hungry, thoughtless boys and girls.

3. *Stale vegetables and meats,* sold very cheaply in city markets, but dear at any price.

4. *Adulterated foods,* as cheap tea and coffee, cheap vinegar, cheap canned goods, etc.

5. *Condiments,* as pepper, mustard, spice, if used in excess.

6. *Injurious drinks,* including all alcoholic drinks, whether home-made or commercial (see Temperance Teachings); tea and coffee, especially if of a poor quality or not properly made.

COMPOSITION OF FOOD.

Starch and Sugar.

Examine dry starch; notice its color, taste, and feeling. Try to dissolve it in cold water. Boil the mixture; observe the result. Dilute the solution; place a few drops on little squares of paper with which the pupils have been provided; add a drop of iodine solution. Have the pupils describe the experiment and the result.

Have different pupils bring different grains and different articles of cooked food of vegetable origin. Crush them and make them into solutions. Add a drop of iodine solution. Describe the experiment, the result, and make an inference in regard to the presence of starch.

Make solutions of unripe fruit and test for starch. Test ripe fruit.

Chew crackers, kernels of wheat and other grains. Observe the change in the taste from starch to sugar.

Refer to the change in the taste of bread after it is baked, especially after it has baked a long time. Name the sugar formed in this manner "starch-sugar," or "grape-sugar."

Taste sweet fruits and vegetables. Discover the sugar. Name this sugar also "grape-sugar."

Taste milk. Observe the sweetness. Name the sugar "milk-sugar."

Name the sugar with which the pupils are all familiar "cane-sugar." Refer to other kinds of sugar, as maple, beet, and sorghum.

Explain the office of starch and sugar foods mainly, and name them "fuel-foods."

(See Atwater's pamphlet, Foods.)

From the experiments performed by the teacher and by consulting tables such as are given by Professor Atwater, make out a list of vegetables and grains that serve as "fuel foods" because of the starch or sugar which they contain, as rice, wheat, corn, potatoes, etc.

Make a list of those that have but little or no starch, as tomatoes, carrots, turnips, cabbage, string beans, lettuce, etc.

Gluten.

Mix different kinds of flour with water. Observe the sticky character of the dough. Name the substance that causes the stickiness "gluten."

Soak kernels of wheat and corn. Make a longitudinal section. Observe the hull, pulp, and germ. Sketch the same on an enlarged scale.

Explain how the outer layers of the pulp are rich in gluten, that this is usually removed with the dark layer or bran in making fine white flour; that the pulp is largely starch, while the germ possesses a food especially good for the brain.

Explain the office of gluten as a food, how it mainly builds up the body, and name it "flesh-food."

Determine with the pupils that the body needs both "flesh-food" and "fuel-food" and therefore all parts of the kernel of grain should be used in making the flour; that for this reason whole-wheat flour and Graham flour are the most wholesome kinds of wheat flour.

Make a list of grains rich in gluten, as wheat, corn, oats, rye, barley, rice, etc.

Describe the fibres or cellulose intermingled with the food elements in grains, vegetables, and fruits. Refer to the necessity of cooking by which process the fibres are softened and the food set free.

Albumen and Casein.

Pour hot water on the white of an egg. Observe the result.

Pour hot water over a piece of lean meat. Observe the result.

Name the substance in the egg and meat that hardened and turned white "albumen." Class it with gluten as a "flesh food."

Make a list of meats arranged in general order according to their value as flesh-making foods.

In general, the nutritive value of animal food increases in ascending the scale of animal life, as, oysters, fish, fowl, quadrupeds—under the last are pork, mutton, veal, and beef.

Add a few drops of rennet to milk. Observe the curd. Name it "casein." Refer to its use. Class it with gluten and albumen.

Fats.

Name animal fats—tallow, marrow, lard, fish oils, butter, etc.

Observe the fat in milk; let the cream rise. Determine why it rises, and whether all fats are lighter than water.

Name vegetable fats—those derived from nuts, olives, seeds, corn, oats, etc.

Explain that the office of fats as food is mainly to furnish heat. Refer to the value of fats as food in cold countries, in winter, and by hard-working people.

THE OBJECT OF EATING.

Growth.

Observe that animals grow; that plants grow. Determine some of the conditions on which the growth of both depends.

Consider the kinds of food required by different animals —grass-eating animals; flesh-eating animals; fruit-eating animals; animals that eat all kinds of food.

Determine the class to which man belongs.

Consider the kind of food man needs especially when he is growing and all parts of the body are building up. Refer to wheat and other grains rich in gluten, to beef, milk, eggs, peas, and beans, as flesh-making foods.

Determine the relative quantities needed by growing children and people who have attained their growth.

One of the strongest incentives to right living with children is the desire to grow tall and strong. Urge the necessity of wholesome food and of abstinence from all things that do not tend to produce growth and strength.

Examine the pupils at different intervals in regard to height, weight, and different measurements of the body. (See Bissell's Manual of Hygiene, "Growth and Development.") Record and compare the results. If they are not satisfactory, try to determine the causes why they are not.

Repair.

Observe the different things the body can do, the voluntary and involuntary acts, its ceaseless activity.

Compare the activity of the body with the activity of a

machine; talk about the wear and the waste that must take place in either; how both must be repaired often; how the human body has the power to repair itself.

Tell the pupils the amount of waste leaving the body daily—about one twenty-fourth of its weight; how, like the waste material of a house or town, it must be carried away; the organs by which it is thrown off from the body —skin, lungs, kidneys, and bowels; how the co-operation or activity of all is necessary that no one of them may be overtaxed.

Determine that all kinds of food are necessary to repair the waste—heat, flesh, and work foods.

Heat.

Feel of the hands and face; place the hands on the trunk under the arms. Observe the heat. Place a thermometer under the tongue. Observe the temperature.

Determine that the heat of the body is maintained by means of food, pure air, clothing, fires, and exercise.

Name the kinds of food best adapted to give heat—those rich in fats, sugar, and starch.

Consider the kind of food eaten in cold climates; in warm ones; the kind eaten more freely by the pupils in winter; in summer.

Consider the effect of alcoholic drinks on the temperature of the body—how the apparent effect at first is to raise it, but the real effect is to lower the temperature and lessen the power of the body to resist cold. Relate instances illustrating the last point.—(See Richardson's Temperance Lesson Book.)

Power.

Give an illustration of physical power; of mental power.

Determine the condition of the body when man does his best work—well developed, in good repair, warm, clear-

headed, strong; how this condition is maintained so far as kind of food is concerned.

DIGESTION.

The aim in teaching this topic is not simply to give a little information in regard to certain organs of the human body, that pupils may know better how to keep them in a state of health, important though this aim may be, but a broader one that will include the former. Lead the pupils to see the provision made for the sustenance of all animal life; to see the unities in that provision by studying comparatively those features adapted to interest pupils of ten or eleven years of age, such as, the need of digestive organs, the general structure of the digestive organs, their function, their adaptation to this function, the common end towards which all the organs work, viz., to grind, dissolve, and change the food, that it may finally be taken to all parts of the body.

First Step in Eating—Conveying the Food to the Mouth.

Observe how man carries the food to his mouth. Find out about customs in different countries in this particular.

Observe how lower animals seize and convey food to their mouths—the monkey by means of its hands; the squirrel, its fore limbs; the cow, its lips and teeth; the bird, its beak and talons; the toad, its tongue; the fish, its jaws; the crab, its claws; insects, their fore limbs, horny jaws or a tube.

Second Step in Eating—Chewing and Swallowing.

Study the human mouth. Observe its position and general shape. Sketch it.

Compare it with the mouths of some of the lower animals in regard to position and shape. Observe the large size of the mouths of flesh-eating animals as compared with those of grass-eating and gnawing animals. Sketch some of the mouths observed.

Observe birds and the pictures of birds and notice how the mouths differ in shape. Find out why they differ. Sketch several beaks.

Tell the pupils, aided by pictures, drawings, and microscopic specimens, about animals whose mouths are not located in the head, as the jelly-fish and the star-fish; about

animals that have no mouths, as the amœba. Have them find the mouths of some of the lower orders of animals, as the oyster, clam, and snail.

Name the part of the human mouth that forms the entrance; the floor; the roof; the sides; the back part. Observe which of these parts are movable.

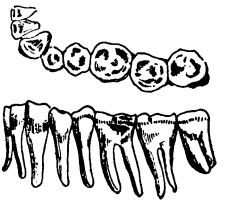
Name animals that have fleshy, movable cheeks and lips; name those that do not have movable cheeks and lips.

Observe the thick lips of grass-eating animals. Compare their lips with those of flesh-eating animals.

Determine the use of the human tongue. Observe its attachment. Feel the bone in the neck to which it is attached. Observe its shape, movement, and surface.

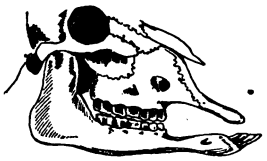
Observe the tongues of different animals, as of a cat, a cow, a horse, a frog, a bird. Find out whether they are long or short, rough or smooth, movable or immovable, attached at the front or back. Find the tongue of a fish.

Observe the human teeth—the number of rows; the different purposes for which they are used, as biting, tearing, and grinding; the different shapes and their adaptation to their work.



Observe the teeth of grass-eating animals—their position and shape, their use; how the jaws move; how

the horse bites the grass; the cow; the sheep. Find out why these animals bite the grass differently.



Observe the teeth of a friendly dog—how they differ in size and shape from those of the other animals observed; why they differ; how the jaws move.

Observe the teeth of a squirrel (a stuffed specimen)—their number, size and shape; their adaptation to the work they do.

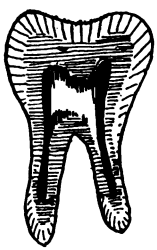
Observe the mouth of a fish and the different parts where the teeth are located.

Determine why the bird has no teeth. Find out what birds have the harder beaks—those that wade in the water or those that live on land.

Find out, by reference to books, what takes the place of teeth in some animals, as in the toad, turtle, and whalebone whale.

Examine a large beetle. Find two pairs of horny jaws. Find out how they move.

Get different kinds of human teeth of a dentist. Make drawings of the different shaped teeth. Name the different parts of the tooth. Show how the tooth is held in place.

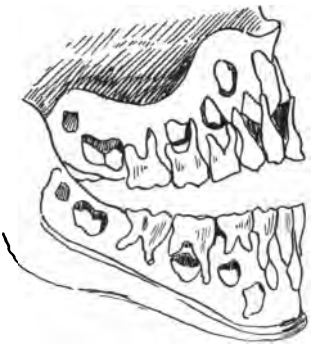


Show a longitudinal section of a tooth. Observe the structure of the tooth and whether all the parts are equally hard or not.

Find out the number of sets of teeth and the number of teeth in each set.

Consider in this connection the impor-

tance of sound teeth—their use in speaking, chewing food, and in preserving the form of the face; their care—manner and time of cleaning; the prevention of irregular teeth; their preservation; the necessity of frequent examination by a dentist.



Observe how the tongue and the cheeks aid the teeth in chewing and swallowing.

Observe the important work done by the saliva in moistening the food. Determine another function of the saliva. Chew kernels of wheat, pieces of cracker, etc., until they taste sweet.

Show the pupils the general location of the salivary glands in their faces. Show pictures of the same. Determine whether these glands are large or small in animals feeding on hay and grain. Show a picture of the salivary glands of a horse.

Study the throat. Find out its use. Observe its position; shape; the seven passages leading out of it—two to the nostrils, two to the ears, one to the mouth, one to the lungs, one to the stomach; the location of the tonsils and the soft palate.

Locate the gullet. Give a general idea of its size; the direction it takes in leading from the throat to the stomach; the action of its walls as soon as food enters it.

Consider the length of the gullet in long-necked birds and animals; the animals in which the gullet is very dilatable and why it is so.

Third Step in Eating—Dissolving and Changing the Food.

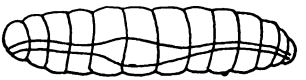
Call the attention of the pupils to the material forming the body, as bone, muscle, fat, blood, etc.

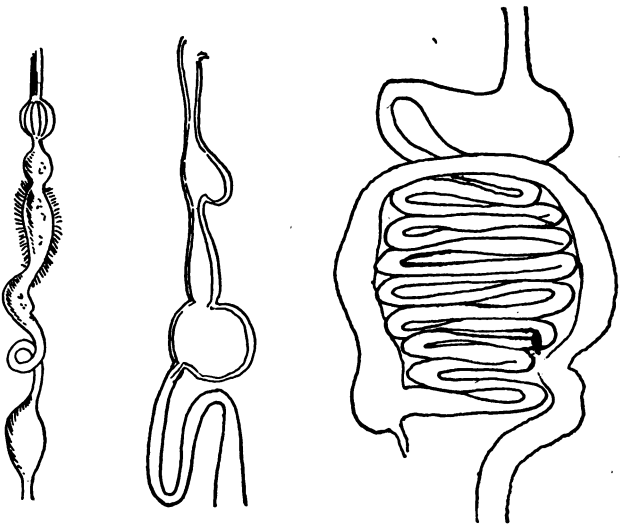
Determine that all these parts are built up by the food that is eaten.

Determine that the food in order to do this work must be dissolved, and changed into a very different substance from what it is when it enters the mouth. Recall the change that takes place in the mouth.

Give the pupils a general idea of the tube or canal extending through the trunks of all higher animals, in which the food is prepared for the body.

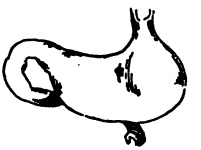
Sketch a diagram of the simple tube in the earthworm and the caterpillar ; of the tube with its several expansions,





as found in the beetle and the fowl. Explain why these expansions are necessary. Sketch a diagram of the tube with its expansion called a stomach, as found in man.

Locate the stomach in the human body. Show a picture of it in its relation to the other organs. Notice the entrance and exit for the food. Determine whether their relative position indicates that the food is to be retained. Sketch an outline of the human stomach.



Consider the average length of time which the food is retained in the stomach; the movement of the stomach; without going into details, the juice poured out by the walls of the stomach on the entrance of food.

Consider the office of the stomach, to warm, dissolve, mix, and change the character of some kinds of food before allowing it to pass into the bowels, or intestines.

Consider the length of the intestines in different animals —how the length depends upon the character of the food, being one hundred and fifty feet in the ox, three times the length of the body in the lion, about four times in man.

Refer briefly and in a general way to the three other juices met with in the intestines by which the food is further changed to a fluid so that it can pass through the walls of the tiny vessels and be carried to all parts of the body.

Fourth Step in Eating—Absorption of the Food.

Illustrate absorption through animal membrane by the following simple experiment: Make a hole in the shell and outer shell-membrane of an egg. Immerse the egg in a glass of water, supporting it upon a napkin-ring. Water passes rapidly through the inner shell-membrane, which becomes more and more distended and finally bursts. (See Bowditch's Hints to Teachers of Physiology.)

Compare the alimentary canal containing the prepared food to the moistened earth about the roots of a plant—how, beginning at the mouth and extending through the intestines, there are tiny tubes whose walls are so thin that

prepared food can pass readily through them as the water did through the membrane of the egg; how only a little food is taken up in this way in the mouth and the gullet —determine why—but more from the stomach and still more from the intestines, two sets of tubes being necessary here for the work of absorbing the food.

PRIMARY AND INTERMEDIATE.

HYGIENE OF EATING.

The teaching of hygiene should not be considered a separate topic, but simply a summary of what has already been taught. As far as possible the pupils have been led to see the normal conditions under which the body, by means of its various organs, lives and works. An effort to preserve these conditions embraces all the teachings of so-called laws of health.

In the primary grades, where the process of digestion is described in a figurative manner, the health teachings, as has been suggested, should be given at the same time as the former, and in the same manner. This method has been found very effective in arresting the attention of little children and leading them to practice the right and healthful thing, where other methods have failed.

Summarize in any grade, by whatever method is deemed most suitable, all that has been taught in regard to the following topics :

1. *Selection of food.*—Nutritious ; suited to the wants of the body ; cheap ; the avoidance of rich, decayed, adulterated foods ; bills of fare for breakfast, dinner, and supper ; lunches—the materials and manner in which they are put up. (See Mrs. Abel's Essay.)

2. *Preparation of food.*—Several reasons for cooking ; methods of cooking vegetable and animal food—such that

the end of cooking may be served and not defeated; seasoning: the value of relishes and their abuse.

3. *Serving of food.*—Invitingly served; table neat and tastily set; plainness, simplicity, coarseness and cheapness of materials is nowise detrimental to the beauty of the table if accompanied by cleanliness and order. Show that the table of the poor can be as ideal as the costly table in these essential factors.

4. *Amount of Food.*—Effect of age upon the amount of food required—the growth and activity of children demanding more, the inactivity of the aged less; the effect of the size of people; the effect of occupation—the hard-working man demanding more than the one who does light work; the effect of climate—cold climates requiring more food than warm ones.

5. *Time of eating.*—Meal-time, occurring two, three, or four times a day, according to custom; a hearty meal to be avoided just before retiring; the mistake in going to bed hungry; the habit of resting for a little time from any kind of hard work after eating a hearty meal.

6. *Manner of eating.*—The cheerful, helpful spirit; the health, comfort, and appearance of the person who eats slowly; the necessity of taking small mouthfuls, chewing thoroughly and drinking moderately.

Touch briefly upon the unhappiness, discomfort, and poor health that result when all the above conditions are reversed; how the habit of drinking and smoking after a meal may be formed by men seeking to forget the effects of a poor meal uninvitingly served and hurridly eaten.

Teach the pupils proper table manners and drill them in the practice of the same. The younger the pupils when this is done, the better. It is a training the children may never receive at home, or from any one, if the teacher does not give it. Select essential points from some simple work on etiquette. Mrs. Dewey's "Teaching Manners in the

School Room" is a handy little book for this purpose; also "Don't." In the latter change the suggestions from the negative to the positive form. Begin with the passing to the table and proceed through the meal deducing, with the children's aid, points like the following: (1) Be on time; (2) wait for the ladies and older people to pass first; (3) remain standing until all are ready to be seated; (4) sit at a comfortable distance from the table; (5) wait until all are served before commencing to eat; (6) hold the trunk erect; move the arms freely, rather than the head; (7) eat soup noiselessly from the side of the spoon; (8) break and spread only a small piece of bread at a time; (9) cut food with the knife, eat it with the fork, lifting or picking it up easily and quietly, etc., etc.

Talk with the children on the above points and lead them to see that in observing them one is only doing the right thing in the easiest, most convenient manner, and giving no offense to others.

GOOD-HEALTH CLUB LEAFLET.

Formulate as many rules on the preceding topics as are deemed most essential by the teacher.

CHAPTER XIII.

WATER.

Helpful Books. — Reynold's Primer of Hygiene; Vaughan's pamphlet, Healthy Homes and Food for the Working Classes; Atwater's pamphlet, Foods; Bissell's Manual of Hygiene; Nature in Verse; standard poets.

SUGGESTIONS IN METHODS.

The aim in the primary grades is not to teach the properties of water in a systematic manner, but to lead the pupils to observe water; to see it in its different forms; to notice its beauty and its use; to cultivate the habit of using water freely; to realize the pleasure and advantage that come from using it. Many of the suggestions given under this topic may seem irrelevant to the subject of hygiene. If the essentials of hygiene alone are taught in an isolated manner, but little benefit will result. Young children, especially, must be thoroughly interested in any topic, their enthusiasm must be roused by one who is herself enthusiastic over the subject, before the lives of the pupils will be influenced by any dogmatic "ought's" and "ought not's" of a hygienic character. If we desire the best results, therefore, the study of the hygienic value of water must be closely linked with Nature Study.

PRIMARY.

FORMS OF WATER.

Observe the different forms of water in nature, as rain, mist, snow, frost, ice, hail, fog, and cloud.

Name those that are solid ; those that are liquid ; those that seem to be neither solid nor liquid, but which float in the air. (It is assumed that the terms "solid" and "liquid" have been previously taught.)

Observe the bodies of water in the locality of the school—brooks, rivers, ponds, etc. Observe whether the water is fresh or salt. Tell about other bodies of water that may have been seen in other places.

BEAUTY OF THE DIFFERENT FORMS.

Liquid.

Observe and describe the beautiful sights in nature produced by water—water shining in the sunlight or moonlight ; the reflection in bodies of water of sky and land; water roughened by the wind, and by flowing over stones or steep rocks ; the dew-drops and rain-drops sparkling on the grass and trees; spray reflecting the sunlight ; the rainbow, etc.

Observe the sounds caused by water—the tapping on the roof and window-panes ; the murmuring of brooks ; the merry tinkling of falling water ; the roar of the surf. (Recite parts of the poem by Southey, "The Cataract of Ladore.")

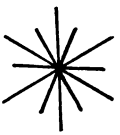
Commit poems to memory like the following : "Merry Rain," "April Shower ;" "Who likes the Rain?" "The River ;" "The Clouds ;" "The Dew ;" "Rain in Summer ;" "Summer Shower ;" "The Rain." (Nature in Verse.)

Sing appropriate songs descriptive of the water found in any school collection of songs."

Solid.

Observe the million gems sparkling on the grass and trees on frosty mornings; the frostwork on the windows —the beautiful scenes traced there by Jack Frost.

Read to the children poems, and commit portions of them to memory, like the following: "Jack Frost;" "Frost Pictures;" "The Little Artist;" "The Frost." (Nature in Verse.)



Examine snow crystals. Observe the different forms, their size, the six points. Observe how tiny and light snowflakes are. Describe their manner of falling by means of an action song.

Picture the great drifts and blockades caused by the tiny flakes, and the roaring torrents and freshets caused by them in the spring.

Observe and admire the scenery in winter—the whiteness of the landscape, the effect of the trees and of sunlight upon the snow.

Consider the pleasures afforded by the snow, as sleighing, coasting, snowballing, building of images, etc.

Place in a mixture of snow and ice a test-tube or a small bottle containing water. Watch the water as it freezes and notice the graceful leaves and slender pencils of ice that form first at the sides of the bottle.

Watch the formation of icicles and notice the beautiful effect of sunlight upon them; the effect of ice on trees and landscape. Describe the ice carnivals held in cold countries; the customs of the people of countries having perpetual ice and snow; the warmth of their houses of ice and snow. Refer to the pleasures afforded by ice.

Associate with the snow poems like the following: "Little Snowflakes," "Little Ships in the Air" and others. (Nature in Verse.) Some of Andersen's Fairy Tales furnish very pretty descriptions of snow scenes—"The Snow Man," "The Snow Queen," "In the Uttermost Parts of the Sea," "The Ice Maiden." Other tales give descriptions of other forms of water, as, of the sea, in "The Mermaid."

Clouds.

Watch the formation of clouds—their different shapes and colors; their glory when seen at sunrise and sunset. Read or commit to memory "The Fog," "The Clouds." (Nature in Verse.)

USE OF THE DIFFERENT FORMS.

Liquid.

Observe that plants need water; how they die without it; how quickly they revive, when wilted, if given water; their strong, fresh appearance after a shower.

Question in regard to the drink used by all animal life, excepting man. Describe the strength, endurance, swiftness of flight, etc., of some of the lower animals. (See Richardson's Temperance Lesson Book, chapter, "Natural Drinks.") Refer briefly to the suffering of animals when deprived of water—how they can endure longer without food than without water.

Consider the value of water to man—how the "House Beautiful" is made up largely of water; how its work is carried on by means of water; that it would be as impossible for the human body to move and work without water as for a steam-engine to do so; that it needs two or three quarts daily to supply its needs.

Consider whether it is better to take this water in a pure form as the beautiful, healthy plants and strong animals do, or to mix with it some article that does not benefit the body.

Describe the refreshment that comes from a glass of cold water; how there is no drink to compare with it in the satisfaction, pleasure, and benefit afforded by it.

Do not ask how many of the pupils drink tea, coffee, beer, or some other drink than water. Ignore their bad habits so far as directing the attention of the pupils to them, and ask how many, with you (the teacher), will, for a certain period named, drink nothing but water or milk. Write this willingness to make the effort in the Good Health Club Leaflet.

Consider a second use of water, viz., for cleansing purposes.

Refer to bathing—the frequent need of it; the refreshment it brings when tired; the tonic effect of the morning bath. (See p. 169.)

Refer to the use of water in cleansing clothes and rooms —how air, sunshine, and water are the great purifiers; the health, comfort, and happiness that result when clothes and surroundings are clean and sweet.

Refer to other uses of water—a motor power for turning water-wheels; a highway for floating vessels.

Solid.

Observe the effect of frost upon plant life—how it seems to injure it, but observe that the plants that are killed by the frost have done their work, while the sturdier ones are warned to prepare for their long winter's nap. Observe the effect upon animal life, some forms dying, some preparing for winter sleep, others inactive and sluggish, resting from the year's labor.

Consider the use of snow—how it protects the earth; makes the air pure; in the spring furnishes water by melting.

Consider the use of ice—the protection from cold that it affords the fish; the valuable use of it in summer to man

in preserving food. Discourage the use of ice in water. Suggest rather the placing of water near ice to cool, bottling it if practicable.

INTERMEDIATE.

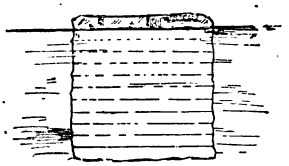
Under this division brief suggestions are given for teaching the forms and properties of water; its wide distribution in nature; its use in nature, and especially to man. Thus the work of leading older children to appreciate one of the best but most common gifts in nature goes on. Not only science, but poetry, must aid in the work. Beautiful descriptions of water may be found in any of the standard poets. Longfellow, Tennyson, Scott, Whittier, and others all furnish these.

SOLID FORM.

Name the solid forms of water observed in nature—snow, ice, hail, and frost.

Produce the solid form from the liquid. Place in a mixture of salt and ice a test-tube or bottle containing water. Observe the formation of the crystals of ice—where they begin to form; their appearance; the temperature of the water at the time of their forming. Find out why salt is added to the ice surrounding the test-tube. As the water in the test-tube freezes, determine whether it is giving or receiving heat; whether the mixture of ice and salt surrounding the tube is giving or receiving heat.

Place a block of ice in water. Observe that it floats.



Determine what proportion of the block is seen above the surface of the water.

Determine how sailors, seeing floating icebergs, can estimate their size.

If ice did not float, determine what would be the effect

of severe climates upon bodies of water and the animal life contained in them.

Consider the effect of ice and snow upon vegetation—how they kill some forms, but protect others from the cold; the purifying effect upon the atmosphere; the effect of the freezing and thawing of bodies of water upon the temperature of the atmosphere; refer to the freezing experiment and determine when heat is given off by bodies of water, and when heat is taken up by them.

Consider the important use of ice to man. Describe briefly the manner of harvesting and storing ice.

Freeze pure water, salt water, and dirty water. Compare the ice and observe that some of the salt and impurities are in the ice. Dispel the idea that ice from any source is pure—that freezing purifies it. Teach that ice should be taken only from streams or lakes whose water may be used for drinking.

Refer to the advantage of artificial ice.

Discourage the use of ice in drinking-water or in beverages of any kind, suggesting rather the bottling of water—boiling it first if necessary—and then placing it on ice.

Emphasize the necessity of drinking ice-cold water in small quantities and slowly—sipping it at intervals.

VAPOROUS FORM.

Boil water. Observe the steam directly over the surface of the water; its foggy appearance higher in the air, and then its disappearance. Compare the volume of steam with the volume of water. Observe its expansive force as it lifts the lid of the tea-kettle. Refer to its mechanical power.

Determine the conditions under which the steam is formed, and why it rises in the air.

Name this form of water that is suspended in the air

"vapor" and the process by which it is formed "evaporation."

Observe other examples of water changing to vapor—the drying of clothes, sidewalks, and grass; fog rising over a stream, etc.

Observe the source of the heat causing the evaporation; how the amount of heat and wind affect the quickness with which the change is made. Name countries and seasons in which evaporation goes on most rapidly. Recall how heat is necessary in order that water may evaporate. If water takes the heat from whatever surrounds it, determine the effect of evaporation upon the atmosphere in warm countries and climates. Explain why sprinkling the streets cools the air; why moisture or perspiration on the skin cools the body.

Bring back the hidden water in the air by condensing it on a surface colder than the surrounding air. The ice-pitcher will answer on a warm day. Observe the steam on the windows; the dew on the grass at night. In winter mix snow and common salt, or add a little strong sulphuric acid to dry snow. Moisture will form on the outside of the vessel containing these mixtures.

Prove that animals give off watery vapor in the breath by watching their steaming nostrils on a cold day, or by allowing them to breathe on cold glass.

Prove that plants give off watery vapor by pressing fresh leaves against cold glass.

Sum up the sources from which watery vapor in the air is derived; the conditions under which it is formed, and the conditions under which it becomes visible.

Observe clouds—determine their origin; why they are in the upper air; why they are visible, and why they become invisible.

Observe fogs, where they are seen usually. Determine why they are visible, why they become invisible.

Observe the dew—its origin; why it becomes visible at night; why grass and leaves are loaded with dew, and other objects often remain dry.

Trace all forms of water—fog and cloud, mist and rain, dew and frost, snow and ice, to the condensation of the vapor in the air.

"The Rain Coach," in Pray's Motion Songs, very prettily describes the rising of the water from the sea into the cloud and then falling again over the land.

Fogs, clouds, mists and other forms of dampness in the atmosphere are too generally looked upon as enemies to health and comfort. Train the pupils to regard even these as beneficial and enjoyable. Observe the gentle but thorough way in which fogs and mists bathe the plants; the protection afforded by the clouds from heat and light when both have been intense; the daily refreshment that comes with the dew. Teach by word and example that these forms of water are none the less enjoyable than the others, if one will only think of their place and value, and not of the inconvenience and discomfort occasioned by damp clothing.

LIQUID FORM.

Physical Properties.

Follow the same suggestions that are given on p. 110 relating to the observation, description, and recording of experiments.

Observe that pure water is transparent, colorless, odorless, and tasteless.

Effect of Heat.—Fill a tin cup even full with water. Heat it. Determine why the cup runs over.

Heat water in a glass dish in which little shreds of filtering paper have been placed. Observe the currents. Account for their direction. Account for the origin and general direction of the currents in the ocean.

Determine which is the heavier, equal volumes of hot or of cold water.

Effect of Cold.—Fill a bowl even full with boiling water. Allow it to cool. Observe whether the water completely fills the bowl.

Fill a bottle with water, cork it tightly, and freeze the water. Account for the bursting of the bottle. Refer to the bursting of water-pipes, the cracking of the earth, and the splitting of rocks by the frost.

Explain to the pupils the peculiar property that water has of both contracting and expanding under the influence of cold—contracting until within four degrees of freezing and then expanding until frozen.

Weigh equal volumes of water and ice and observe that the water is the heavier. Refer to the floating block of ice and the advantages that come from the fact that ice floats and does not sink.

Conductive Power of Water.—Fill a test-tube two-thirds full of water. Place a small thermometer in the bottom. Hold the tube over a flame so that only the upper part of the water is heated. Observe whether there is any change in the temperature of the water at the bottom of the tube. Make an inference in regard to the power of water to conduct heat.

Owing to the power of water to conduct heat slowly, determine the effect of bodies of water upon the climate of adjoining countries.

Solvent Power of Water.—Dissolve salt, sugar, and other soluble substances in water. Use both hot and cold water in the experiments and determine the effect of heat and of cold upon the solvent power of water. Observe the clear appearance of the water after some of these substances are dissolved in it, and thus learn that the clear, sparkling appearance of water is no proof of its purity. Owing to the solvent power of water determine the effect of water

upon rocks and soils and in the formation of caves. Observe that the same property renders water hard, salt, mineral, and impure.

Different Kinds of Water.

Name the different terms applied to water—spring, well, rain, river, salt, mineral, hard, soft, impure, distilled, etc.

Discover five principal sources from which towns may be supplied with water—the rain; wells and springs beneath the earth's surface; rivers and lakes on the earth's surface.

Illustrate the difference between hard and soft water by trying to produce a lather with soap from each. Boil the hard water and make a second trial. If it is not softened, the water is said to be "permanently hard." Teach the meaning of this term.

If different soils have been studied, intelligent reference can be made to the cause of hard water—its flowing through chalk and limestone soils. Decide which is better for all purposes, hard or soft water. Refer to soils that give soft water—granite, slate, gravel, loose sand.

Think of conditions under which the last two might not give pure water.

Consider objections to rain-water—its unpalatableness; its uncertainty; its impurity in towns where the air is not pure or the surface clean on which it falls. Consider the purity of rain-water if these latter conditions are reversed; the value of rain-water for washing purposes; why it is free from hardness.

Water Supply.

If the pupils live where they can make observations in regard to the location and structure of wells, instruction on the following topics will be of practical value.

Observe different yards and streets and determine good places for the location of wells; objections to having the well lower than a house or barn or too near these buildings; the advantage of having deep wells, especially those cut off from the surface by a layer of hard rock.

Make a rough sketch illustrating the location of houses on hills or sides of a valley. Represent a layer of hard earth between two layers of sand as shown in the sketch. Locate wells at different points, as *a*, *b*, *c*, *d*, *e*, etc., and determine whether they will be pure or impure.

Sum up the following points for the location of wells—distant from or higher than any refuse or sewage heap; cut off from surface water by a hard rock layer of earth.

Observe the structure of the well. Determine the necessity of cementing the sides; of raising the surface about the mouth of the well and of paving it; the advantage of a pump over a bucket.

Consider the difficulty of supplying large cities with water—the necessity of using river or lake water; the danger in using these waters; how the source from which water is taken should be free from all sewage from towns or factories; the condition of the reservoirs in which it is stored; the means for purifying water, both natural and artificial; objections to the use of lead pipes for the distribution of water.

Consider the kinds of impurities in water—mineral, animal, and vegetable.

Consider the best means of purifying water—by boiling

it for at least ten minutes, and by filtering through sand or charcoal. Deseribe the general features of a filter-bed—the layer of very fine sand upon the surface, with coarser sand and gravel below.

Sum up the characteristics of good drinking-water—cool, clear, odorless, tasteless, sparkling, not too hard, and free from animal and vegetable matter.

Sum up the sources from which water is obtained as *wholesome,* if from elevated regions above sewage, from deep wells or from springs; *doubtful* or *dangerous,* if from surface wells on cultivated lands, from cisterns, or from a river water.

Distribution of Water.

Observe the wide distribution of water in nature.

Determine how this distribution is effected. Consider the following topics: The ultimate source of all fresh water, viz., the watery vapor in the air; its condensation and the rainfall of a region; the forming of streams, lakes, and rivers; the sinking of water into the soil, forming springs and wells; the evaporation of a portion and the wafting of it by the wind to other regions; the absorption of another portion into plant and animal life.

Prove that water is absorbed by plants. Place a plant in a fruit-jar or bottle having water enough in it to cover the roots of the plant. Mark the height of the water. Pack cotton around the opening of the jar to prevent evaporation. Observe the height of the water in a few days. Account for the apparent loss of water. Require the pupils to grate and squeeze different kinds of vegetables and observe the amount of water they contain. Observe the water in fruits. Weigh unpeeled apples and peeled ones. In several days weigh them again. Account for the loss in weight in the peeled fruit. After a few experiments the

pupils will be interested in the table that may be placed on the board from Atwater's pamphlet, showing the proportion of water in different vegetables, fruits, and grains, as potatoes, 78 per cent.; turnips, 89 per cent.; cabbage, 91 per cent.; apples, 83 per cent.; wheat, 12 per cent.; oatmeal, 7 per cent., etc.

Show the presence of water in minerals. Place a crystal of washing soda or of copper in a dry, cold bottle. Heat the lower part of the bottle by holding it over the chimney of an ordinary lamp. Observe the moisture forming on the glass inside the bottle and account for it.

Name the parts of the human body of which water forms a part—every organ may be named.

Use of Water in the Human Body.

Find out some of the offices of water in the human body: how it dissolves the food and carries it from the mouth to the stomach; forms a part of the fluids that further dissolve and change the food and carry it into the blood; makes up the greater part of the volume of the blood and thereby carries nourishment to every part of the body; aids in carrying off the waste from the body by means of the skin, lungs, kidneys, and bowels; regulates the temperature of the body by evaporation from the surface.

Make inferences in regard to the importance of water as a food. Consider the amount required daily in order that the body may be well supplied—from two to three quarts, one-third being usually contained in the food and two-thirds in the liquids drunk; the amount allowable at meals, especially if the food is not watery—one or two glasses, providing it is not too cold and is sipped moderately. Consider the different forms in which water is drunk—hot, cold, iced, boiled and then cooled, tea, coffee, cocoa, alcoholic drinks, etc.

Consider the objections to drinking water in some of these forms. Ice-water cools the stomach, delays digestion, causes dyspepsia; if drunk in large quantities when the body is heated, it sometimes causes death. Tea and coffee are entirely unnecessary to growing children; these drinks hinder digestion, do not promote growth, weaken the nerves, and spoil the complexion. Alcoholic drinks, because of their general injurious effects upon all parts of the body, especially upon the nerves, and because the habit of using them is easily formed and almost impossible to control, leading finally to the weakening, if not to the ruin, of the body and mind, are to be shunned entirely.

Refer, as in the lower grades, to the highest types of physical strength and beauty, and make them attainable only by using the most healthful food and drinks.

Use of Water for Cleansing Purposes.

The Bath.—Consider the necessity of the bath, viz., for health and refreshment; the different kinds of baths; the best time of day for the bath; the temperature of the bath; the length of time to remain in the bath—reviewing other topics relating to the bath that have already been taught in connection with the care of the skin.

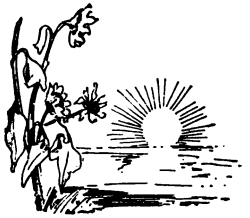
Cleansing Houses.—Consider the value of hard floors, of unpapered walls and ceilings, to which water can be applied. Consider the origin of dirt, visible and invisible, viz., from cooking, activity of all kinds, breathing, sickness; the necessity of the thorough house-cleaning at least once a year, when hot water can be applied to everything possible.

Refer to the amount allowed for drinking, cooking, and cleaning purposes for each person in the water-supply of large cities—from 35 to 85 gallons.

GOOD-HEALTH CLUB LEAFLET.

Formulate statements or rules relating to the use of water for

1. Cleansing purposes.
2. Drinking purposes.
   - *a.* The kind of water.
   - *b.* The manner of drinking.
   - *c.* The location of wells.
   - *d.* The use of ice.



CHAPTER XIV.

SUNSHINE.

Helpful Books.—Works on geography, astronomy, and physics, necessary for teaching the correlated topics; Reynold's Primer of Hygiene; Nature in Verse; the standard poets.

SUGGESTIONS IN METHODS.

PRIMARY.

USE AND BEAUTY.

Train children to appreciate the best "gift" to all living things, viz., sunshine. Lead them to see the benefits derived from it and the beauty afforded by it; to love it and look for it in every room, building, and yard.

Make the pupils aware of the presence of sunshine in different places. Call their attention to it in the schoolroom.

Observe the light, warmth, and sweet refreshing odor imparted to the air of a room into which the sun is shining.

Observe the friendliness of the sun—how it gives to all light, warmth, and beauty; how the flowers turn their faces to it and follow it in its course all day; the smile

with which it is greeted when it suddenly shines through a cloud on a dark day.

Observe the effect of the sun's light and warmth upon plant life; the condition of a plant growing in a cellar; the change that takes place when it is brought out into the sunshine. Tell why, in our climate, plants thrive best, with some exceptions, in a south window. Refer to some of the lower orders of plants that grow better in the shade.

Discover how man and animals are dependent on plant life for food, whether they eat grains, fruit, or flesh.

Discover how man is dependent on plant life for his clothing, whether he wears cotton, linen, woollen, or skins.

Discover how man is dependent on plant life for artificial heat, whether he burns wood, coal, or oil.

Determine what would be the effect on man if there were no plant life; what would be the effect on plant life if there were no light or warmth from the sun.

Relate incidents showing that animals love the sunshine. Talk about the necessity of sunshine in buildings occupied by animals. Tell the pupils about the solariums in hospitals, where patients can take a sun-bath; the effect upon the growth and health of people who are deprived of sunlight; the condition of people living in the dark six months at a time.

Determine that sunshine is necessary in all buildings and in all rooms, making them light and cheerful and the air pure; revealing the dirt and helping to remove impurities and dampness.

Make on the blackboard a list of all the rooms in a house. Underline with a yellow crayon those that usually have plenty of sunlight. Consider the condition of closets, garrets, cellars, closed parlors; how these, too, should be thrown open to the sunlight, or else the articles in them should be taken out frequently into sunlighted air.

Consider the need of sunlight in cellars, sick-rooms, and yards.

Observe, whenever there is an opportunity, the beautiful sights in nature caused by the sun, e.g., the rainbow; gold-edged clouds; sunlight on the water, dew, frost, ice, and snow; the glories of sunrise and sunset; the sun shining among the trees in the woods or along the street. Ask the pupils to report at different times, orally or in writing, what they have observed lately along this line.

There are many pretty poems on the sun, sunshine, sunbeams, etc., in "Nature in Verse" that are adapted to little children. These may be read to the pupils and stanzas from them committed to memory.

INTERMEDIATE.

THE SUN—ITS WORK.

Sum up the benefits thus far discovered that are derived from the sun—the source of life to plants and animals; a purifying agent.

Observe different kinds of power by which work is done, as, hand-power, horse-power, steam-power, etc. Trace the source of each back to the sun—e.g., hand- or horse-power, dependent on the food eaten, animal or vegetable, which is dependent for its life on the sun; steam-power, dependent on the heat from the coal and wood, which owe their existence to the sun.

Refer to the industries that are thus dependent upon the sun indirectly.

Refer to the industries dependent directly upon the sun's rays, as, photography, bleaching, farming, etc.

Observe how quickly the sun changes water to vapor. Watch the disappearance of the rain and dew, of dampness on the floor or streets, the formation of clouds, fogs, etc. Refer to the study of water and recall the benefits derived from evaporation—forming of rain, dew, etc.

Call the attention of the pupils to the fields of ice and snow in late winter; the human impossibility of removing them; the swiftness, silence, and steadiness with which the Sun sends down his rays—and, presto! they are gone. Call their attention to the bare earth and trees in early spring and then observe the change that steadily creeps over Nature until she is clothed in brilliant green—all owing to the constant work of the sun. Observe and write descriptions of the work of the sun in other seasons.

Watch the course of the sun during the day and from day to day in different seasons. Discover whether there is a change in the direction and length of a shadow cast at 9 A.M., 12 M., and 3 P.M. in different seasons. Observe the relation of the shadow to the position of the sun and the heat received from it.

Show how the position of the earth in relation to the sun causes the different seasons.

Determine that the sun causes the winds. Find out whether the air grows warmer or cooler as one leaves the earth and moves toward the sun—refer to snow-capped mountains. Infer that the air is not heated by the sun's rays passing directly through it, but by the heat that is reflected or radiated from the earth. Recall from the experiments with air the effect of heat upon air, and the movement of currents of air in a room. Determine then how the warm air about the earth will move; the cold air—and thus the winds blow.

Consider the influence of the sun in causing currents and tides in the ocean.

THE SUN—ITS NATURE.

Associate with this topic a little astronomy, telling the pupils something about the nature of this master workman. 1. What the sun is—a great sphere sending out light and heat in every direction, appearing no larger than the

moon, but really so large that the earth, with the moon revolving around it, might be placed at the centre of the sun and there still be 200,000 miles extending beyond. 2. Where it is—so far away that it would take an express train nearly 350 years to travel from the earth to the sun, and a signal-sound announcing the arrival of the train would be fourteen years reaching the earth.

Teach in a comparative manner the amount of light and heat sent out from the sun.

Refer to Experiments with Light (see p. 101). Review some of the topics, as, how rays of light travel, how they are reflected, how they are bent, the spectrum, etc.

SUNSHINE AND THE POETS.

As in the lower grades, call the attention of the pupils to the beauties in nature caused by the sunshine.

Read from different poets poems whose theme is sunshine, as, Whittier's "Sunset on the Bearcamp"; Longfellow's "An April Day," "Sunrise on the Hills," "A Day of Sunshine," "Sundown," "Daybreak"; Bryant's "A Walk at Sunset," etc.

Read the tale from Andersen, "Sunbeam and the Captive."

"The Dawn of Day" is a pretty action song that could be used in this connection. (Pray's Motion Songs for Public-Schools.)

SUNSHINE AND HEALTH.

Consider the location of houses with reference to sunshine—the gloom and dampness caused by having trees too near; the beauty, pleasure, and protection afforded by having them at a distance; the necessity of space all around a house, and, in the city, of a wide street in front.

Consider the ifferent rooms in the house—how they should all be light, cheerful, and airy; the principal living-

rooms facing east, south, and west, lighted by broad windows, all of which can be opened.

Consider the danger of dark, damp cellars; how the ceiling should be higher than the level of the ground outside, so that light and air can enter.

Consider the advantage of having the sleeping-rooms upstairs.

Consider the necessity of sunshine in all buildings, public or private, that are occupied at any time by man; the necessity of sunshine in those occupied by animals.

Talk with the pupils about the health, strength, and feeling of buoyancy that comes from breathing air purified by sunshine.

Train the pupils from early years to take deep breaths of sunlighted air the first thing in the morning immediately after dressing.

Train them to appreciate the freshness and sweetness resulting from placing clothing and bedding in the morning sunlighted air.

GOOD-HEALTH CLUB LEAFLET.

Formulate statements or rules relating to the following:

1. Sunlight in all buildings.
2. Throwing open all living-rooms daily to sunlighted air.
3. Exposure of clothing and bedding to sunlight.
4. Daily practice of deep breathing of sunlighted air.

CHAPTER XV.

CLOTHING.

Helpful Books.—Lindley's Health in the Home, Bissell's Manual of Hygiene, Reynold's Primer of Hygiene, Ecob's Healthful Dress.

SUGGESTIONS IN METHODS.

Select from the following such topics as are suited to the different grades.

PRIMARY AND INTERMEDIATE.

USES OF CLOTHING.

Refer to the normal temperature of the human body—during exercise ; during rest and sleep. Compare with the temperature of some of the lower animals, as, birds and fishes.

Refer to the causes of heat in the body. Find three ways by which the body parts with heat. Determine the result if too much heat is allowed to escape and if too much is retained.

Consider the importance of clothing in helping nature to maintain the right temperature.

Refer to the protection of animals—the wool of the sheep, the hair of the dog, the fur of the cat, the skin of the elephant, the feathers of the bird, etc.

Determine other uses of clothing than that of protection from heat and cold—protection from dirt and injury.

HEAT-CONDUCTORS.

Prove that some substances are better conductors of heat than others.

Thrust one end of rods of iron, copper, glass, and wood into a flame. Observe the heat at the opposite end of each rod. Make an inference.

Refer to the experiment under "Water," proving that water is a poor conductor of heat.

Prove that air is a poor conductor of heat. Hold with one hand one end of a wire in a flame. Hold the other hand the same distance from the flame as the hand holding the wire. Observe that the wire conducts heat to one hand, while the air does not to the other.

Feel of different substances in the room, as, zinc, iron, glass, marble, wood, etc. Observe that some feel colder than others. Prove by means of a thermometer that all have the same temperature. Explain that marble feels colder than wood because the marble is a better conductor of heat and takes the heat more readily from the hand.

Feel of different materials of cloth, as woollen, cotton, and linen, and try to determine by the touch which kind is the best and which the poorest conductor of heat.

MATERIALS FOR CLOTHING.

Name different materials used for clothing. Trace them to their origin in the animal and vegetable kingdoms.

Name materials suitable for winter and determine why they are suitable.

Determine why fur is so well adapted to cold climates.

Determine why loosely woven materials are warmer than those closely woven.

Determine why new garments are warmer than old ones.

Determine why loosely fitting garments are warmer than tightly fitting ones.

Determine why several thin garments are warmer than a very thick one.

Name materials that are suitable for summer because of their good conductive power.

Consider the effect of color as a protection against the heat of the sun. Explain how some colors absorb heat more than others—white the least, being therefore the coolest in summer, yellow next, then green, red, and black. Apply this fact to clothing suitable for different seasons.

Test wool, silk, linen, and cotton with reference to their absorbent qualities. Observe the large amount of water woollen will absorb without feeling wet. Consider the advantage of materials that possess this absorbent quality.

Consider the conditions under which woollen should be worn next to the skin in summer as well as in winter.

Consider how the very young and the very old especially, need the protection afforded by woollen.

Consider all the reasons why clothing should be porous. Name circumstances under which leather, oil-skins, and india-rubber are worn for dress. Consider objections to the constant wearing of these materials.

Sum up the qualities that the best materials for dress possess—warmth, power to absorb moisture, and porosity.

FORM OF DRESS.

Consider the necessity of clothing the body evenly—the upper and lower limbs being well protected.

Consider the weight of clothing—how it should be as light as possible and supply the proper warmth; the objection to heavy skirts; the advantage of knickerbockers in preference to heavy flannel skirts; the objection to heavy hats and heavy shoes.

Consider the freedom, health, and comfort that come from supporting all the clothing from the shoulders—dress-

skirts, trousers, stockings, and combination woollen underwear being supported in this manner.

Consider the comfort, health, and freedom, the beauty, ease, and grace, the forgetfulness of dress and of self, that come from wearing loosely fitting clothing.

Consider the evils especially of the corset—compressing the internal organs so they cannot do their important work; weakening the muscles of the trunk by giving unnatural support and interfering with the circulation; deforming the bony walls of the chest by locating and shaping the waist as nature did not locate or shape it.

Consider the evils of the tight garter, the tight collar, and tight shoes.

Consider how the normal human body is sufficient for its own support from its head to its feet and needs no artificial help.

Name occasions that call for different styles of dress. Determine that the beauty of dress depends upon its fitness for the occasion.

CARE OF CLOTHING.

Consider the necessity of clean, dry clothing.

Consider why clothing, especially woollen, should be aired, shaken, and brushed.

Consider the necessity of changing flannel frequently.

Consider the necessity of removing at night all clothing worn during the day, of shaking it, and of allowing the separated pieces to air in a dry room.

GOOD-HEALTH CLUB LEAFLET.

Formulate rules relating to the following:

1. Brushing of clothing daily.
2. Complete change of clothing at night.
3. Clean clothes on all occasions.
4. Loose clothing.
5. Light clothing simply made.

CHAPTER XVI.

EXERCISE AND REST.

Helpful Books.—Bissell's Manual of Hygiene, Reynold's Primer of Hygiene, Lindley's Health in the Home, One Hundred Gymnastic Games, Hunt's Handbook of Light Gymnastics, Stoneroad's Gymnastic Stories and Games.

SUGGESTIONS IN METHODS.

Reference has been made to the need of exercise under preceding topics, and different forms of exercise have been suggested. In Primary grades reasoning with the pupils in regard to exercise is not necessary. Little children will exercise from instinct. Play and gymnastic games in which the pupils are guided by the teacher will furnish the needed exercise.

As the pupils grow older, in this, as in other things, they demand a reason for actions. Something of the effect of exercise on the organs of the body, its value in promoting health, strength, and development, the different kinds of exercise, the time and place for exercise, may be taught with good effect, the pupils being influenced by this information to persist in doing intelligently that which in earlier years they did instinctively.

The following is mainly a summary of points to which reference has already been made under preceding topics.

INTERMEDIATE.

EFFECT OF EXERCISE.

Compare a piece of machinery that has been a long time idle with one in active use; the condition of a long-vacant building with the condition of one that has been constantly occupied.

Call attention to the human house—how all its parts are suited to active work.

Consider the effect of exercise on the different organs—on the muscles, making them larger, firmer, stronger, readier to act in the performance of movements; on the joints, rendering them supple and easily and quickly moved; on the heart, increasing its movements and causing the blood to flow more rapidly to all parts of the body; on the lungs, causing deeper and quicker breathing, expanding and strengthening them; on the digestive organs, stimulating them in their work and increasing the appetite.

Relate to the pupils instances of increase in weight, height, and different measurements as a result of exercise that have been recorded by instructors in physical training. (See Bissell's Manual of Hygiene.) Keep a similar record of the development of the pupils.

Sum up and picture the ideal human form—its muscles active, joints supple, frame symmetrical, heart beating strongly, lungs well developed, skin glowing with health—all depending in a great measure upon proper exercise.

Picture the reverse condition owing to lack of exercise—the flabby muscle, accumulation of fat, deformed spine, flat chest, sluggish circulation, and general ungainly, ungraceful, unhealthy appearance.

KINDS OF EXERCISE.

Consider the value of exercise taken in the open air.

Consider the different kinds of exercise that may be taken

in the open air, the advantages of each kind, the conditions under which it may be taken, the objections to it, if any.

Walking.—Represent it as one of the best forms of exercise. Consider the proper pose for walking (see p. 53); the swinging pace; comfortable dress; the effect upon internal organs; the parts of the body getting the most exercise, those getting the least; the value of forming the habit of walking daily amid pleasant surroundings, the distance to be determined by the condition of the one taking the exercise.

Rowing.—Consider the exercise afforded the back legs and arms by this form of exercise; the effect upon the heart and lungs.

Swimming. — Consider the movements in swimming; how every part of the body is called into action.

Wheeling.—Consider the value of wheeling as a means of taking the rider into the open air for exercise; the enjoyment it affords, acting as a tonic for tired nerves; the exercise afforded the legs and the muscles of the abdomen and back; the effect upon breathing and circulation; the healthful and graceful position for ordinary riding; the comfortable, safe dress; the objections to riding for speed and in a bent position; the danger of cooling off too quickly.

Consider in the same manner as the above other forms of exercise.

Consider the value of gymnastic exercises indoors when exercise in the open air is impossible.

Consider the value of regular exercise—that muscles may become trained to work with ease and without weariness.

Consider the circumstances under which housework or farmwork may furnish the necessary exercise—when it is varied so that all parts of the body are called into activity, which is usually not the case; when the movements, as walking, reaching, stooping, lifting, etc., are properly made;

when there is joy felt in doing the work, which is a most important element in beneficial exercise.

Consider the necessity of regular exercise for the brain as well as for other parts of the body.

Consider the evil of any form of exercise if practised to excess or under conditions not favorable to health.

REST.

Observe the periods of rest and activity in nature. Consider the effect of constant activity or use upon anything, lifeless or alive.

Consider the value of frequent rest for a few minutes during study or work.

Consider the value of resting an hour during the day.

Consider the manner of resting — by changing the form of work, and by ceasing entirely from all work.

Consider the necessity of the sound night's sleep; the refreshment that it brings; the condition of one sleeping —the slow breathing, slow pulse, relaxed muscles, absence of thought, every part of the body being at rest.

Consider the amount of sleep necessary for infants, children, grown people.

Consider the best time for sleep and the value of a regular hour for retiring and rising.

Consider the conditions conducive to sound, refreshing sleep—bedroom quiet, dark, moderately warm, and well supplied with pure air; springs, mattress, and pillow comfortable; clothing light, warm, and clean; feet warm; hunger satisfied; mind free from work and worry.

GOOD-HEALTH CLUB LEAFLET.

Formulate rules relating to the following:

1. The daily walk.
2. Regular exercise indoors, if necessary.
3. Regular hour for retiring and rising.

CHAPTER XVII.

TEMPERANCE TEACHINGS.

Helpful Books.—Stevenson's Boys and Girls in Biology, Bergen's Elements of Botany, Richardson's Temperance Lesson Book, Wood-Allen's Marvels of Our Bodily Dwelling. Some of the latest editions of school physiologies contain valuable information for the teacher that is easily available. The *School Physiology Journal*, published by Mrs. M. H. Hunt, 23 Trull St., Boston, aims to print quotations from German and other foreign periodicals which are not otherwise obtainable in English.

SUGGESTIONS IN METHODS.

Throughout this book, in almost every chapter, there have been given suggestions that refer either directly or indirectly to the teaching of temperance. A brief summary of important points may be helpful to the teacher.

PRIMARY.

1. Little children will imitate those whom they love and in whom they have confidence. Therefore win the confidence and love of the pupils, and so live that your life may be a safe model for them in all matters pertaining to health. Your attitude against the use of alcoholic drinks and tobacco is, with such pupils, the strongest argument why they should not use them.

2. Interest little children in healthful ways of living and

lead them to practise such. Recognize in this work, as in all other primary work, the importance of holding before young minds correct models or ideals. Make the pupils familiar with the noblest types of manhood and womanhood of the past and present.

3. Teach simple facts about the human body in such a manner that the children will feel that they live truly in a "House Beautiful," and that they must live so as to keep it pure and beautiful.

A boy admires and desires a tall form, a broad chest, strong, well-developed muscles, a quick eye and ear. Appeal to this desire and the boy may be led to shun those things that would deprive him of these physical advantages.

"Questionable Guests," "Treacherous Companions," "A Deceitful Friend," "The Foe of the Household" of the "House Beautiful" are treated in separate chapters of Marvels of Our Bodily Dwelling. They will be found suggestively helpful in method of teaching to primary grades the effect of alcoholic drinks, tobacco, and other narcotics.

4. Literal statements in regard to the effect of alcoholic drinks, tobacco, etc., will be appreciated only so far as the structure of the body is comprehended. Since primary pupils study mainly external features of the body, teach mainly general effects of injurious articles, as, their effect upon growth, size, strength, and the senses.

5. It is a rule in training little children to say as little as possible about things that are to be avoided. An effort is made to divert the attention of the children from things that are dangerous and evil to those that are safe and right. Do not, therefore, enter into lengthy, minute descriptions of the different processes by which alcoholic drinks are manufactured. Under the study of fruits and grains, that are made as attractive as possible in their natural state, refer to their abuse in crushing them into

drinks, such as wine, beer, and cider. Observe the sweetness, refreshment, and harmlessness there are in the juice of fruits when it is in the fruit or when first pressed out. Tell the pupils that the sweet juice changes after it has been exposed to the air a little while and is no longer the harmless drink that it was at first, that there is a little bit of a substance in it called alcohol that makes all drinks made in this way dangerous for people to use who wish strength, health, and happiness.

6. Since in most children's minds the word poison means something deadly in its effects, be sure that the true meaning of the term is understood before defining alcohol as a poison, or else the facts taught will seem at variance with their daily observations.

7. Since alcoholic drinks are used freely in many of the children's homes, care must be taken not to reflect unpleasantly upon the lives of those whom the pupils love and respect. In settling this question, as other questions pertaining to cleanliness and health, ignore the practices of other people and lead the pupils to decide the matter, each one for himself alone. When the opportune time comes—and it may come in connection with the study of water and its value, as well as when teaching the effect of alcoholic drinks—lead the pupils to decide with you that, as they wish the best health possible, they will use only the most healthful drinks, viz., water or milk. Have the pupils enter this decision in the Good-Health Club Leaflet.

INTERMEDIATE.

If children form in early years the habit of using only wholesome drinks, unless some strong influence to the contrary is brought to bear, they will be likely to use such throughout their lives. Hence the importance of employing such methods of teaching temperance in the lowest grades as shall lead the children to form this good habit.

As children grow older they demand a reason for their actions. The reason, if comprehended, strengthens the habit, giving it an intelligent basis that will help it to stand and continue in the day of temptation. Hence the need and the value of teaching the nature, origin, and effects of alcoholic drinks and narcotics. To those of careless habits and weak wills this knowledge may mean but little. But to those who have been trained in good physical habits, whose judgment has been constantly exercised in deciding upon matters pertaining to health, whose wills have been trained to apply to the conduct of their lives their knowledge of healthful and unhealthful things—to such, truths relating to the nature, origin, and effects of alcoholic drinks and all narcotics will be a most valuable means of strengthening or determining their attitude in regard to the use of these articles. Therefore impart scientific truth and train pupils to yield to the truth always in all things.

NATURE OF ALCOHOL.

That pupils may have an intelligent idea of the substance about which so much is said at the present day, that they may know its use as well as its abuse, the following experiments with alcohol are suggested. They are to be performed by the teacher in the presence of the pupils.

Look at alcohol and observe that it is colorless and transparent. Smell of it and notice its peculiar, penetrating odor.

Observe that it flows more easily than water.

Place a few drops of alcohol on the back of the hand. Observe how it cools the hand and quickly evaporates. Expose alcohol and water to the same degrees of heat. Observe how much more quickly the alcohol evaporates than the water.

Heat alcohol until it boils. Observe its boiling temperature—about 173° F.

Try to freeze alcohol. Determine why alcohol is sometimes used to fill thermometers.

Compare the solvent power of alcohol with that of water. Try to dissolve in both, substances like camphor, resin, shellac, different oils, etc.

Put a little alcohol into a saucer. Apply to it a lighted match. Observe that it burns with a blue flame with but little smoke. Mention its value in the alcohol-lamp.

Observe that alcohol hardens animal tissues, such as the white of an egg or a piece of meat. Refer to its use in preserving animal structures. Make no inference in regard to its effect upon live tissues.

Tell the pupils that alcohol took the water from the specimens in the preceding experiment. Tell them of the attraction that alcohol has for water, taking it from the air or from any substance with which it comes in contact; that it is difficult to obtain absolutely pure alcohol, the purest that is generally used being five per cent. water.

Tell the pupils that alcohol is usually classed as a poison, one definition of a poison being "any substance which tends when taken into the body to injure or kill it."

Consider the effect of alcohol upon life—plants and the lower animals—how no form of life can resist the injurious or destroying effects of alcohol if taken into the system in sufficient quantity.

Consider the proportion of alcohol in the liquors most commonly used as beverages—a little more than half in brandy; a quarter or less in wine, depending on the kind; from one-tenth to one-twentieth in beer.

Consider how it is the nature of alcoholic drinks to create in the person who uses them an appetite for drinking that often becomes uncontrollable, and leads the person to physical, mental, and moral ruin.

ORIGIN OF ALCOHOL.

Fermentation.—Dissolve a quarter of a cake of compressed yeast in about a tablespoonful of warm water. Add this to a pint of warm water in which two tablespoonfuls of molasses have been dissolved. Place the mixture in a quart fruit-jar, cover it loosely, and let it stand in a moderately warm place (about 70° F.) until the following day.

Observe the bubbles of gas escaping from the mixture. Lower a lighted match into the jar and observe the effect upon the flame.

Fill a test-tube with the mixture from the jar and invert it over a saucer of the mixture. Leave it all night. In the morning the gas will have pushed the yeast out. Put a piece of paper under the test-tube and raise it from the saucer. Pour the gas in the test-tube into a test-tube containing limewater. Shake and observe the effect. Refer to experiments with air, and recall the name of the gas that will not support a flame and turns limewater white.

Pour some of the mixture into a test-tube. Close the tube with a rubber stopper through which passes a short glass tube. Hold the test-tube over a flame—the chimney of an ordinary lamp will answer—until the mixture boils. Apply a lighted match to the opening of the tube. Observe the blue flame. Determine that something must be present in the jar that is entirely different from anything in the original mixture. Recall the experiments in which alcohol or the vapor of alcohol burnt with a blue flame. Name a second substance being formed from the mixture.

Name the process by which carbonic-acid gas and alcohol are produced—"fermentation."

Boil some of the yeast and see if it will cause fermentation. Freeze it and try the experiment again.

Sum up from the preceding experiments the conditions

necessary for producing alcohol, viz., molasses, water, yeast, a certain degree of heat, and time.

Apply these conditions to home-made beer and other drinks to which yeast has been added in their making, and determine whether they have alcohol or not.

Apply the same conditions to bread-making. Determine whether carbonic-acid gas and alcohol are formed; what becomes of the carbonic-acid gas; how it makes the bread light; what becomes of the alcohol. Refer to the low temperature at which alcohol evaporates. Determine why bread will not rise if it is mixed with too hot water or placed too near the fire to rise.

Let fruit-juice ferment. Test for carbonic-acid gas and alcohol. Apply the conditions discovered for causing fermentation. Observe there are sugar and water, but that no yeast has been added. Where did the yeast come from that caused fermentation?

The Yeast-plant.—Valuable aid for teaching this topic can be obtained from Stevenson's Boys and Girls in Biology, a work based on a series of lectures given by Prof. T. H. Huxley. The first chapter, What the Boys and Girls Found in a Spoonful of Yeast, is especially helpful. Bergen's Elements of Botany, chapter xxiii., Some Types of Flowerless Plants, will furnish the desired information, also many of the school text-books on physiology.

Show the pupils through the microscope a specimen of yeast. If the microscopic work is impracticable, drawings of yeast-cells may be made by the teacher from plates such as are given in Bergen's Elements of Botany and Boys and Girls in Biology. But nothing will give the pupils so vivid an idea of the reality of these plants—their size, arrangement, and appearance—as a microscopic specimen.

Observe the little roundish bodies. Notice whether they are alone or in groups. Tell the pupils into how many parts an inch would have to be divided in order to have a

part equal in size to one of these bodies—about three thousand parts.

Tell the pupils and illustrate (see Boys and Girls in Biology) how the plant grows—by budding and producing other plants.

Describe the conditions under which it grows; the food it demands—sugar and water; the temperature—about 70° F.; the presence of air.

Tell the pupils that because this little body eats and grows in this manner it is known to be a live plant.

Tell the pupils that the plant breaks up the sugar in order to get the food it wants, and there are left in place of the sugar other things quite different among them two that have been discovered. Refer to the carbonic-acid gas that escaped in bubbles and the alcohol that were formed in the first experiment.

Tell the pupils how these tiny plants become dry and float about in the air, and show no signs of life until they fall into a liquid suited to their growth, viz., sugar and water.

Refer to the fermented fruit-juice, and determine now where the yeast came from. Determine why canned fruit, sealed hot, does not ferment.

Name different beverages and articles of food, and determine whether they offered conditions favorable for the growth of the yeast-plant, and for the production, therefore, of alcohol.

EFFECT OF ALCOHOL.

The effect of alcohol so far as it is known and is suited to the comprehension of the pupils should be taught in connection with each division of the subject of physiology.

ANTI-CIGARETTE LEAGUES.

The Anti-Cigarette League movement in New York City and in other cities proved one of the most successful measures for arresting the habit of cigarette smoking among school boys that has ever been attempted. A copy of the constitution and by-laws of the league can be obtained of Robert B. Keyser, 230 West 95th Street, New York.

The appeal to the manhood and patriotism of the boys; the appeal not to one, but to all the boys to band together, against the use of the cigarette; the appeal coming from the principal of the school, are features that explain the enthusiasm that was roused and the success of the movement. At one time 30,000 boys wore the badge inscribed, "The cigarette must go," having promised to abstain from cigarette smoking until they were twenty-one years of age.

GENERAL REMARKS.

In attaining the end of temperance in the lives of the pupils all the teacher's knowledge of child-nature and of true principles of teaching must be brought to bear upon the work. If giving information with reference to the nature and effect of alcoholic drinks and tobacco were all that were necessary, the problem would be comparatively simple. In order that these warning lessons may be taught effectively a very important and difficult work must be done, the success of which is dependent upon the character and ability of the teacher. The pupils must be led to appreciate the wonderful structure of the body, the conditions under which it will do its best work, and the means by which it is sustained in health and strength. They must be inspired with a desire to possess the best health possible, and a willingness to live, in every particular, in such a manner that it may be attained. Pupils who have been

trained to do the right and healthful thing in other particulars, knowing the effect of alcoholic drinks and tobacco, can have but one attitude towards these injurious articles, viz., to leave them alone.

I would therefore say to the teacher, *work, win,* and *wait:* work for days and weeks, if necessary, along other lines pertaining to good living; win the confidence of the pupils and lead them slowly, but surely, to better living; wait patiently for the time to arrive when the harm done by the habit of smoking and drinking will be thoughtfully and seriously considered by them.

The teaching of temperance is a difficult and delicate task. But the subject must be taught; conditions of society, as well as legal enactments, demand that it shall be done. How it can be done successfully is a problem every conscientious teacher should be trying to solve.

The Best Educational Periodicals.

THE SCHOOL JOURNAL

is published weekly at $2.50 a year and is in its 25th year. It is the oldest, best known and widest circulated educational weekly in the U. S. THE JOURNAL is filled with *ideas* that will surely advance the teachers' conception of education. The best brain work on the work of professional teaching is found in it—not theoretical essays, nor pieces scissored out of other journals. The Monthly School Board issue is a symposium of most interesting material relating to new buildings, heating, and ventilation, school law, etc., etc.

THE PRIMARY SCHOOL

is published monthly from September to June at $1.00 a year. It is the ideal paper for primary teachers, being devoted almost exclusively to original primary methods and devices. Several entirely new features this year of great value.

THE TEACHERS' INSTITUTE

is published monthly, at $1.00 a year. It is edited in the same spirit and from the same standpoint as THE JOURNAL, and has ever since it was started in 1878 been the *most popular educational monthly published*, circulating in every state. It is finely printed and crowded with illustrations made specially for it. Every study taught by the teacher is covered in each issue. The large chart supplements with each issue are very popular.

EDUCATIONAL FOUNDATIONS.

This is *not* a paper, but a series of small monthly volumes, $1.00 a year, that bear on Professional Teaching. It is useful for those who want to study the foundations of education; for Normal Schools, Training Classes, Teachers' Institutes and individual teachers. If you desire to teach professionally you will want it. Handsome paper covers, 64 pp. each month. The History, Science, Methods, and Civics of education are discussed each month, and it also contains all of the N. Y. State Examination Questions and Answers.

OUR TIMES

gives a *resumé* of the important news of the month—not the murders, the scandals, etc., but the *news* that bears upon the progress of the world and specially written for the school room. It is the brightest and best edited paper of current events published, and so cheap that it can be afforded by every pupil. 30 cents a year. Club rates, 25 cents.

*** *Select the paper suited to your needs and send for a free sample. Samples of all the papers* (40 *cents worth*) *for* 20 *cents.*

E.L. KELLOGG & CO., New York and Chicago.

Spring and Summer School Celebrations

EXERCISES, TABLEAUX, PANTOMIMES, RECITATIONS, DRILLS, SONGS FOR CELEBRATING EASTER, MAY DAY, MEMORIAL DAY, FOURTH OF JULY, CLOSING DAY IN THE SCHOOLROOM.

60 Pages. Price, 25 Cents Postpaid.

You have general exercises in your school, do you not? Then you need this book and should send for it now. It is illustrated. It contains nearly *one hundred* fresh, charming, mostly original selections.

PARTIAL TABLE OF CONTENTS:

Easter Song,
Give Flowers to the Children,
Easter in Early Days,
Sir Robin,
To the Flowers,
Wreath Drill and March,
Easter Time,
Tableaux for Longfellow's King Robert of Sicily,
A Bunch of Lilies.
Greeting to May,
A Call to the Flowers,
A Carpet of Green,
To the Cuckoo,
To the Arbutus,
May and the Flowers,
The May Festival,
Gathering Flowers,
The Return of the Wanderers,
The Nation's Dead.
In Memoriam,
Zouave Drill,
Program for Memorial Day,
The Blue and the Gray,
The Nation's Birthday,
Stand by the Flag,
Flag of Our Nation Great,
Boy's Marching Song,
The Poet's History of America,
Etc., Etc.

Fancy Drills and Marches.

MOTION SONGS AND ACTION PIECES FOR ARBOR DAY, CHRISTMAS DAY, MEMORIAL DAY, AND PATRIOTIC OCCASIONS.

Price 25 Cents Postpaid.

THE LATEST, BRIGHTEST, AND BEST BOOK OF DRILLS.

Teachers who want something new and bright in the line of drills will certainly be greatly pleased with this book. One drill alone—Betz's Flag Grouping—has heretofore been sold for the price of this book, 25 cents.

PARTIAL TABLE OF CONTENTS:

Fancy Ribbon March. *Carl Betz.*
Hatchet Drill for Feb. 22.
Christmas Tree Drill.
Wand Drill. *Mara L. Pratt.*
Delsarte Children. *M. D. Sterling.*
Zouave Drill.
Scarf Drill.
Wreath Drill and March.
Rainbow Drill.
Glove Drill.
Tambourine Drill.
Flag Grouping and Posing. *Carl Betz.*
Two Flag Drills.
The March of the Red, White, and Blue.

Also many Motion Songs and Action Pieces. Full directions with each; fully illustrated.

Kellogg's Series of Special Day Books. Latest and Best!

How to Celebrate Thanksgiving and Christmas in the Schoolroom.

FOR THE PRIMARY, GRAMMAR, AND HIGH SCHOOL.

This book consists of Recitations, Songs, Drills, Dialogues, Exercises, and Complete Programs for celebrating Thanksgiving, Christmas, and Autumn Days in the Schoolroom. Its use will save teachers much time and labor and insure an attractive and successful program.

Two Important Features of the book are the carefully prepared complete programs, and the suggestions following every selection as to the most effective use of it. This will save the teacher much labor. Attractively bound in heavy manila cover.

PRICE 25 CENTS, POSTPAID.

A FEW OF THE GOOD THINGS

in the book are here given. There is room to give only a part of the contents.

RECITATIONS FOR CHRISTMAS.

Christmas Eve.
Christmas Bells.
The Very Best Thing.
The Christmas Tree.
The Merry Christmas Time.
The Stocking's Christmas.
A Surprise for Santa Claus.
Merry Christmas.
The Day of Days.
Kris Kringle.
The Bells.
Christmas Echoes.

EXERCISES.

An Autumn Poet (Bryant).
In the Autumn.
Autumn Leaves.
Autumn Thoughts.
The Return of Thanksgiving.
Thanksgiving Exercise for Little Children.
What the Months Bring.
Thanksgiving in the Past and Present.
The Gifts of the Year.
The Mistletoe Bough (for Reading and Tableau).
Christmas Tree Drill.
A Visit from Santa Claus. (Tableaux).

SONGS FOR THANKSGIVING.

Reward of Labor.
Thanksgiving Song.
Fill the Baskets.
A Song of Gladness.
What Little Folks Can Do.
Motion Song for Thanksgiving.

New Year and Midwinter Exercises

Recitations, Quotations, Authors' Birthdays, and Special Programs for Celebrating New Year and Midwinter in the Schoolroom. For the Primary, Grammar and High School.

PRICE, 25 CENTS, POSTPAID.

Do you want help in preparing a program for Charles Dickens' birthday, Feb. 7th? A Dickens' exercise in this book gives selections from his writings, a list from his writings and their purpose, and many interesting things about him. It contains also a Robert Burns' Exercise for January 25, which will be found excellent.

In the country schools "A Winter Evening Entertainment," contained in this book will occasion a great deal of interest.

Original recitations and exercises appropriate for the winter months are not easy to find. This collection contains excellent ones.

E. L. KELLOGG & CO., New York & Chicago.

Teachers' Professional Library.

Consists of thirteen little volumes, neatly and durably bound in flexible cloth covers. This library deals with education on the pedagogical side—History of Education, Biographies of Great Educators, Psychology, Child Study. It is designed for the busy teacher who has little time, but wishes to obtain a general view of these important subjects. **Price, 25 cts. each.**

1. Reinhart's History of Education
2. Reinhart's Principles of Education
3. Reinhart's Civics of Education
4. Blackie's Self Culture
5. Browning's Aspects of Education
6. Rooper's Apperception
7. Hall's Contents of Children's Minds
8. Hall's Study of Dolls
9. Hall's Study of a Sand Pile
10. Kellogg's Outlines of Psychology
11. Rooper's Object Teaching
12. Lang's Outlines of Herbart's Pedagogics
13. Lang's Great Teachers of Four Centuries

We will send the set postpaid for $3.00 cash in advance. *We will also furnish it on the installment plan with six months in which to complete payment. For terms address the publishers.*

E. L. KELLOGG & CO., 61 E. 9th Street, New York.

Valuable Recitation and Singing Books.

Reception Day. 6 nos.

A Series of Dialogues, Recitations, etc. 6 Nos. ready. These contain a collection of fresh, original dialogues, recitations, class exercises, and primary pieces. No scenery or stage-fittings are required. It is the best collection we have ever seen for school use. Here are the actual contents of each number:

No. 1.
22 Dialogues.
29 Recitations.
14 Declamations.
17 Primary Pieces.

No. 2.
29 Recitations.
12 Declamations.
17 Dialogues.
24 Primary Pieces.
8 Class Exercises.

No. 3.
18 Declamations.
21 Recitations.
22 Dialogues.
Class Exercises.

No. 4.
9 Class Exercises.
8 Dialogues.
21 Recitations.
23 Declamations.

No 5
6 Class Exercises.
24 Dialogues.
16 Declamations.
36 Recitations.

No. 6.
7 Class Exercises.
6 Dialogues.
6 Declamations.
41 Recitations.
15 Primary Pieces.
4 Songs.

Kellogg's Best Primary Songs

Is a new book just issued containing about 100 of the best primary songs. These are well suited to the middle and lower grades and especially to district schools; many songs have action to them; there are a few hymns. It is a very useful book and will be worn out wherever used. Nicely printed, durably bound, yet note the low price. Price, 15 cents each; $1.50 per doz. postpaid.

Kellogg's Song Treasures

Is a well-known and popular book of which many thousands of copies have been sold. Themes and words are appropriate for young people. Nature, the Flowers, the Seasons, the Home Our Creator are set to beautiful music. Many of the old favorites are here, some with new words. Fully described in large catalogue. Durably bound. Price 15 cents each. $1.50 per doz. postpaid

Baxter's Choice Dialogues,	12	cents
Castle's School Enterta nments,	27	"
Denison's Friday Afternoon Dialogues,	28	"
Fountain Song Book Series. Nos. 1, 2, & 3. Each,	15	"
Hanson's Merry Melodies,	15	"
Hanson's Merry Songs.	30	"
Hanson's Primary and al sthenic Songs,	48	"
Historical Charades,	10	"
Pricha d's Choice Dialogues.	20	"
The Helper in School Entertainments,	25	"
The Story of Our Flag,	8	"

Send for special 16-page circular describing these and several hundred other recreation books on sale by us. Address

E. L. KELLOGG & CO., 61 E. Ninth St., New York.

BOOKS —BY— T. G. ROOPER.

These are the authorized editions, complete with topic headings and other aids for the student and are half the price of others.

APPERCEPTION:

OR "A POT OF GREEN FEATHERS," is a very simple book on psychology—strange as the title may seem. It discusses perception and shows how perception becomes apperception. It is a book that any teacher may read with profit. Commissioner Harris recommends it, so do other eminent educators. Remember this edition has many special points of excellence. It is accurate, has paragraph headings, is clearly printed and well bound in limp cloth.

Price 25c.; to teachers, 20c.; postage 3c.

OBJECT TEACHING:

OR WORDS AND THINGS. The author has done an important service to teachers in pointing out thus clearly the foundation principles on which the much-talked-of but little understood subject of Object Teaching should be based.

It takes a simple subject—the Duck—and gives a very clear and correct exposition of the right methed of Object Teaching by a series of lessons. The teacher will be set to work in the right direction by reading it. There are plenty of books which furnish material for Object Lessons; no other that gives so admirably the principles and method.

This edition is published by special permission of the author who has written a preface and added topic headings and questions for the student.

Limp cloth, 16mo. Price 25c.; to teachers, 20c.; by mail, 3c. extra.

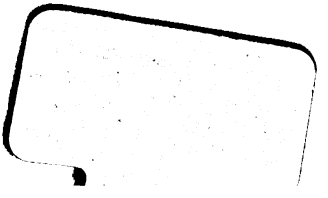
STUDIES AND OCCUPATIONS.

Suitable for Children between the ages of 7 and 9. Everything that Mr. Rooper writes is instructive and interesting. This is a practical and suggestive discussion of what should be the child's work in school between the ages of seven and nine, with a time table, or program based upon the author's ideas. It is reprinted from the Summer Number (1894) of THE SCHOOL JOURNAL. Only a limited edition has been issued and it will not be reprinted.

Manilla Covers. Price, 15c. postpaid.

DRAWING IN INFANT SCHOOLS:

A STUDY IN PRACTICAL PSYCHOLOGY. All of Mr. Rooper's writings on educational topics are based upon careful observation and experiment, and are extremely practical and interesting. This little book is no exception. Everyone interested in the study of the mental development of the child should read it.

Manilla Covers. Price, 15c. postpaid.

E. L. KELLOGG & CO., NEW YORK & CHICAGO.